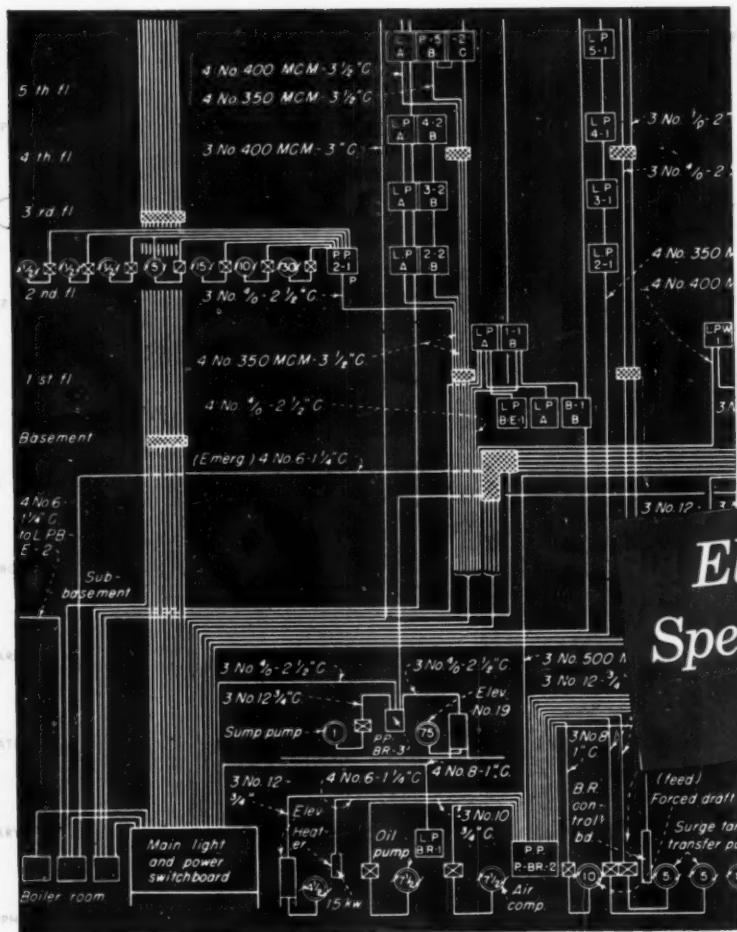


PRICE ONE DOLLAR

Electrical Specifications Issue



A MCGRAW-HILL PUBLICATION

51ST YEAR

HORN,

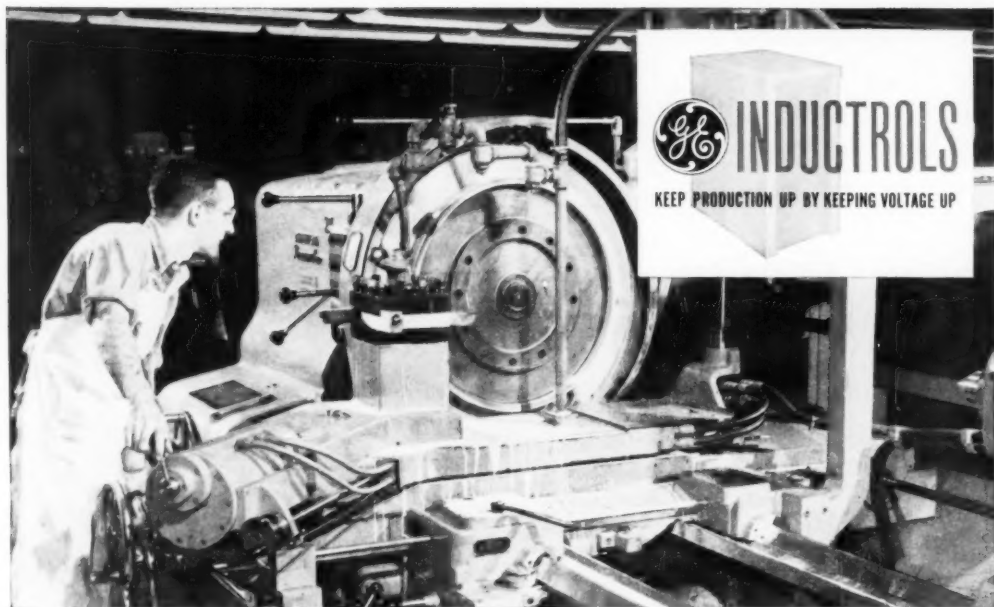
—(X)— EXIT LIGHT OUTLET

M	MAID'S SIGNAL PLUG
---	--------------------

CONTROLLER.

D ELECTRIC DOOR OPENER

(M) MOTOR



Good Lamp Voltage Saves You Money!

Reduce lamp replacements . . . Maintain high production and quality workmanship with proper lighting.



G-E INDUCTROLS can be obtained for both manual and automatic operation, and both single- and three-phase circuits in sizes from 3 kva, 120 volts up to 500 kva, 600 volts.

Your plant lighting operates most efficiently at rated voltage. Undervoltage reduces the brilliance of all your lamps, and workmanship suffers. Overvoltage increases your lamp replacement costs.

That's why it pays to install G-E Inductrols. These new dry-type voltage regulators automatically maintain correct voltage for your plant lighting and other electric equipment, thus assuring peak op-

erating efficiency. All-steel cabinets, attractively styled, protect personnel by completely enclosing all live parts.

For more information on Inductrols, contact your local G-E sales representative or authorized agent. Write for bulletins GEC-712, GEC-795 and GER-341, *General Electric Company, Schenectady 5, New York.*

404-90

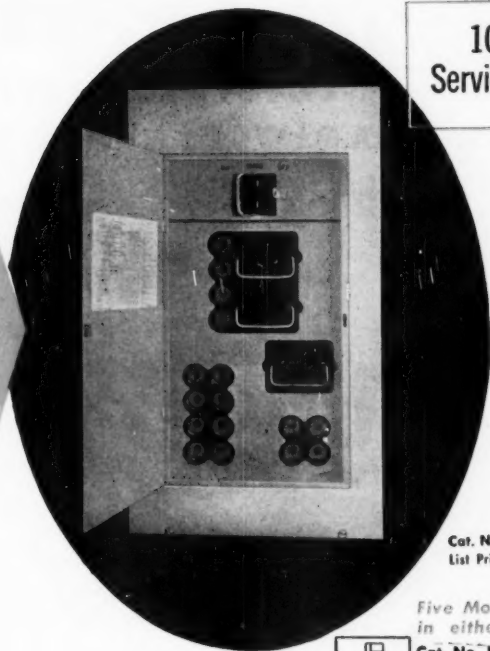
HOW POOR VOLTAGE LIMITS YOUR PLANT EFFICIENCY

LAMP TYPE	10% Undervoltage	10% Overvoltage
Incandescent	Cuts light output 30%	Life cut 70%—Triples replacements.
Fluorescent	Cuts light output 10%; lamps may go out or fail to start.	Lamp life shortened drastically and unpredictably depending on frequency of starting, type of ballast, etc.
Mercury Vapor	Light output cut 15 to 25%; lamps go out with 15% undervoltage.	Even 5% overvoltage overheats lamp shortens life. May damage lamp transformer.

G-E Inductrols are ideal for light-dimming applications

GENERAL  ELECTRIC

ANOTHER NEW *Murray* PRODUCT



100 Ampere
Service Equipment

Cat. No. PC316A
List Price — \$74.00

HERE'S A "Packaged" SOLUTION TO INCREASING LOADS

Murray's "Combination" units will solve your main switch and distribution panel problems—

1 THEY PROVIDE BOTH SERVICE ENTRANCE AND BRANCH DISTRIBUTION IN ONE UNIT.

These Murray "Combination" service entrance and branch distribution units provide 100 Ampere main circuit breaker, fusible range and water heater pullouts, lighting and appliance plug fuse branch circuits—with or without a dryer pullout!

2 THEY PROVIDE FOR GROWING ELECTRICAL LOADS.

Any one of these five compact units offers a packaged solution to increasing loads. They are ideal for small commercial and large residential installations.

3 THEY SAVE TIME AND MONEY IN INSTALLATION.

Murray "Combination" units will save you time and money all along the line. Just one unit to buy—just one unit to install—just one unit to wire!

Factory bussing makes these units easy to wire. There's plenty of wiring room and all K. O.'s are conveniently located. Hook-on cover uses only two screws. Compact! Only 12-3/4 inches wide, designed to fit between building studs.

4 THEY GIVE DEPENDABLE CIRCUIT PROTECTION AT ALL TIMES.

Fully magnetic circuit breaker main consists of two independent trip, 1 pole, 100 Ampere 120/240 volt AC fully magnetic circuit breakers. Carries full rated load continuously. Handle bar permits simultaneous manual tripping to "off".

Murray's well-known fusible pull-out construction provides positive electrical contact. One piece fuse clip and blade prevents overheating.

Five Models to Choose from
in either surface or flush.

Cat. No. PC212A

100 Ampere main, fully magnetic circuit breakers
60 Ampere range fusible pullout
30 Ampere water heater fusible pullout
12 plug fuse branch circuits

List Price — \$57.00

Cat. No. PC216A

100 Ampere main, fully magnetic circuit breakers
60 Ampere range fusible pullout
30 Ampere water heater fusible pullout
16 plug fuse branch circuits

List Price — \$64.00

Cat. No. PC220A

100 Ampere main, fully magnetic circuit breakers
60 Ampere range fusible pullout
30 Ampere water heater fusible pullout
20 plug fuse branch circuits

List Price — \$71.00

Cat. No. PC312A

100 Ampere main, fully magnetic circuit breakers
60 Ampere range fusible pullout
30 Ampere water heater fusible pullout
30 Ampere dryer fusible pullout
12 plug fuse branch circuits

List Price — \$67.00

Cat. No. PC316A

100 Ampere main, fully magnetic circuit breakers
60 Ampere range fusible pullout
30 Ampere water heater fusible pullout
30 Ampere dryer fusible pullout
16 plug fuse branch circuits

List Price — \$74.00



Write for full
information to:

MURRAY MANUFACTURING CORPORATION
1250 ATLANTIC AVENUE • BROOKLYN 16, N.Y.

Service Entrance & Meter Equipment • Fully Magnetic Circuit Breakers • Switches (Types A, C and D)

Current Limiting Reactors • Crows' Nest Aerial Ladders

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . JULY, 1952

When You Want the Best...

Specify **APPLETON** ELECTRIC FITTINGS and EXPLOSION-PROOF Equipment



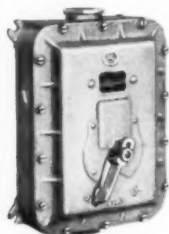
"CES" Series Explosion-proof Receptacles and Plugs



"CPSI" Series Explosion-proof Receptacles and Plugs



Type "FSQX" Explosion-proof Switch and Receptacle, also Plug



Left: "NFB" Series Explosion-proof Circuit Protector and Switch



Right: Type "FLS" Explosion-proof Switch



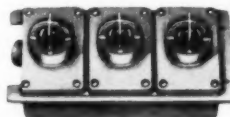
Type "EVHS" Explosion-proof Hand Lamp



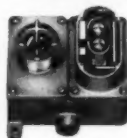
"AA-51" Series Vented Type Explosion-proof Lighting Fixtures, also Type "EVGL" Explosion-proof Gauge Lamps



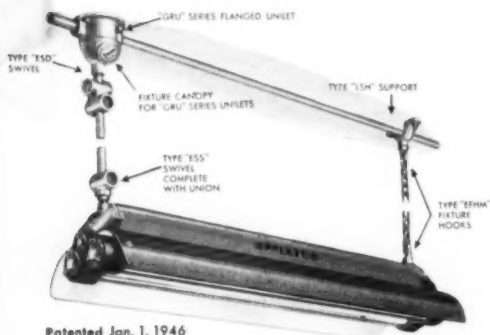
Type "ARTC" Explosion-proof Tumbler and Push Button Switch Unlets



"EFD" Series Explosion-proof Pilot Lights



Type "VSUF" Explosion-proof Visible Sealing Unilet

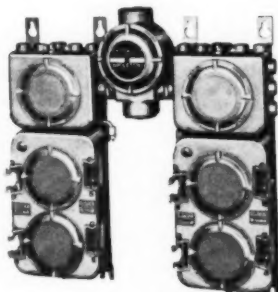


Patented Jan. 1, 1946
Patent 2,392,202

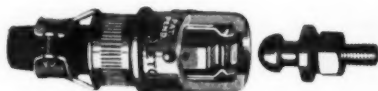
Type "EFU" Explosion-proof Fluorescent Lighting Fixture suspended more than 12 inches from Canopy with "GRU" Flanged Unilet, Fixture Canopy and Type "ESD" and "ESS" Swivels



Type "FLPU" Explosion-proof Panelboard



Type "ELP" Panelboard



Type "TGPR" Grounding Plug and Receptacle



Type "AE" Explosion-proof Reel

SOLE THROUGH ELECTRICAL WHOLESALEERS
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ELECTRICAL CONSTRUCTION AND MAINTENANCE

with which is consolidated Electrical Contracting, The
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Published for electrical contractors, industrial electricians, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management, in the field of electrical construction and maintenance.

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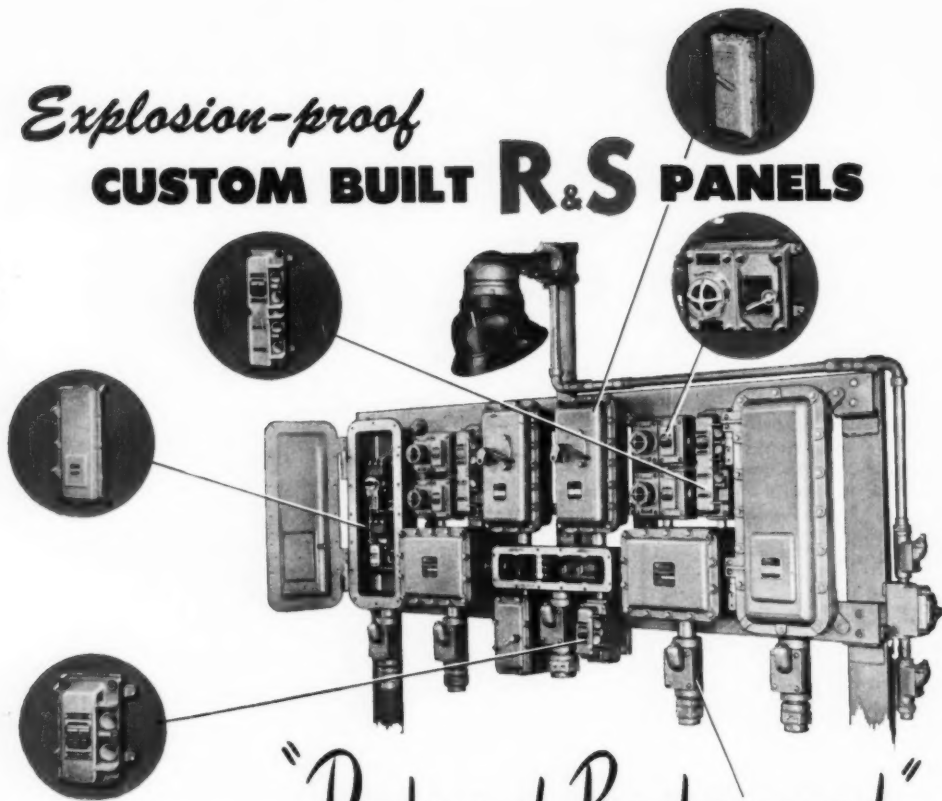
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Explosion-proof CUSTOM BUILT R&S PANELS



HAVE A

"Packaged Background"

Russell & Stoll custom built panels utilize standard R & S equipment as "packaged" components wherever possible. Note how well this better, faster, more economical construction method has been employed on the oil pipe line plant panel illustrated.

R & S thereby by-passes all the uncertainties, delays and expense of "special design" equipment. R & S panels are factory built, sealed and tested, offering simplified construction and pre-engineered performance.

No panel can be better than any of its component parts. And every R & S panel has benefits that stem from selection and use of precision-made units from the complete R & S explosion-proof line. R & S circuit breakers, switches, pilot lights, push button stations and other control devices have standout advantages such as removable front covers, abundant wiring space and conduit openings — in addition to individual features that meet all standards, *plus*.

WRITE FOR CATALOG NO. H47-4

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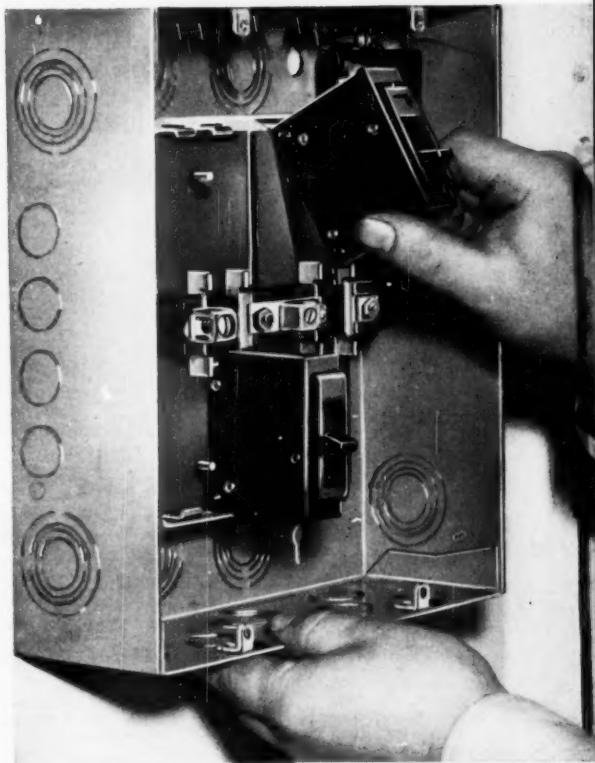
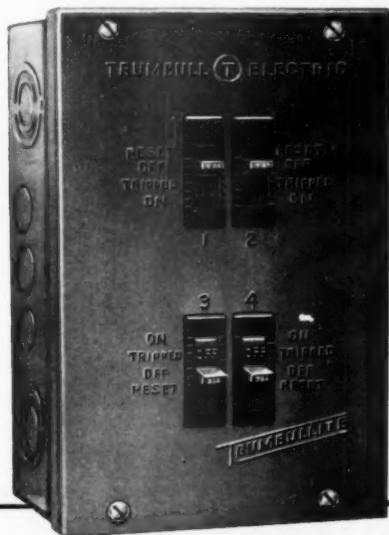
PRECISION-BUILT ELECTRICAL EQUIPMENT—SINCE 1902

Now... TRUMBULLITE at a new low cost!

**New load centers with
plug-in breakers
now priced lowest on the market**

NEWS! Trumbull is now offering TRUMBULLITE Load Centers from one through eight circuits at a *lower cost than that of any load center on the market.*

With TRUMBULLITE, everyone gets more and pays less. *Distributors* like the unique TRUMBULLITE design and assemble-to-order packaging that makes possible lower inventories. *Contractors* cut installation time with quick mounting features and extra knockouts. And *customers* get the highest quality load-center protection available anywhere.



PLUG-IN BREAKERS SLIP EASILY INTO PLACE on this TRUMBULLITE eight-circuit unit. The busbar and stab assembly will accept any Trumbull Type TQL breaker of 10, 15, 20, 30 or 50 amp rating at 120 or 240 volts a-c or 120 volts d-c. Complete line covers load centers to 20 circuits. Four-circuit TRUMBULLITE at left.

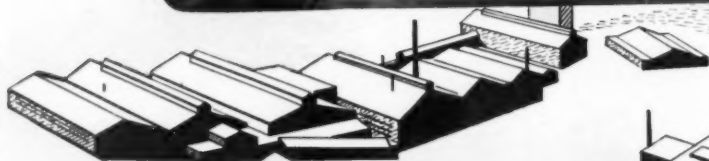
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DEPARTMENT OF GENERAL ELECTRIC COMPANY

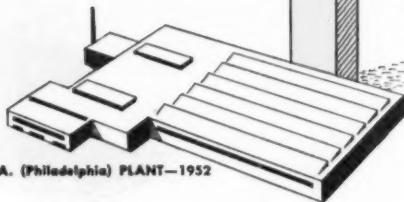
PLAINVILLE, CONN.

**Proudly . . . we announce
our new company name, and
our ultra-modern new Plant!**

Morrisville (Philadelphia), Pa.



ETNA, PA. (Pittsburgh) PLANT—1905



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TWO PROUD EVENTS in our 50-year history—(1) the construction of our new plant adjacent to the Fairless steel works at Morrisville, Pa.—and (2) the conversion to using our nationally-accepted "Brand Name" as our new official company name . . . PITTSBURGH STANDARD CONDUIT COMPANY. The quality of manufacture so inherent in our Enameled Metals Company name—is now to be increased with new capacity, new modern equipment, greater steel tonnages, and faster service to our nation-wide markets.

Now more than ever, for better wiring protection, look to PITTSBURGH STANDARD—"The Standard of The Trade."

Rigid Steel Conduit and E.M.T.

Electro-Galvanized
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Hot Dip Galvanized
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MEETS THE TEST!

**A GENERAL PULLOUT WAS HAND-OPERATED
10,000 TIMES
WITHOUT A BREAKDOWN!**

An independent, impartial laboratory subjected a General pullout to this strenuous test. It passed, surpassed itself.

10,000 COMPLETE CYCLES IS A LOT OF EFFICIENCY!

Every General product is designed to meet these difficult performance requirements. It is one of the many important reasons why you can fully rely on General — for years of maintenance-free usage . . . for unquestionable quality . . . tough construction that can withstand any test.

Next time, make sure it's a General — It's been tried and proved before you use it!

LOOK FOR THESE FEATURES!

• Trims quickly removed with new single screw assembly • More spacious wiring area • Varied and plentiful knockouts • Extra solderless connectors on bus assembly for "tap-off" • Ample contact area carries rated load without undue voltage drop • Electrolytically pure copper contacts • Improved heat dissipation keeps mechanism cooler • Large pullout handle any housewife can operate • All pullouts have flush mounting ears.



"the switch is to General"

General's complete line of Single—Double—Triple and Quadruple pullouts are manufactured in all popular combinations.

WRITE FOR CAT. #5201

ENCLOSED SAFETY SWITCHES • SERVICE ENTRANCE-EQUIPMENT • BRANCH CIRCUIT PANELS

OUT with Costly Outages!

GET PERMANENT DEEP-DOWN PROTECTION WITH

Copperweld

SECTIONAL GROUND RODS



Removable stud bolt
takes driving blows

← Threaded bronze coupling

Any of these Copperweld
Sectional Rods may be used
as a top, intermediate, or
bottom section. They are
roll-threaded on both ends.

As each Copperweld Sectional
Ground Rod is driven, the next
rod is joined to it by means of
a heavy bronze coupling, and
the driving procedure is then
repeated. It's as simple as that.



In most localities deep grounding will provide low resistances more economically than multiple shallow grounds. More and more engineers are turning to Copperweld® Sectional Ground Rods for this deep-down protection. These superior ground rods do the job quickly, permanently and at low cost.

Copperweld Sectional Ground Rods have a stiff alloy steel core to provide the rugged strength for easy driving. This core is permanently protected from corrosion by a thick, molten-welded layer of copper having high conductivity. No other ground rod has this inseparable molten-weld which eliminates the possibility of electrolytic action.

Whether you drive only a few lengths by hand or penetrate the earth's sub-surface with the aid of a power hammer, you can do it quicker, better, and at low cost with Copperweld Sectional Ground Rods. And at the same time, you'll get permanent and consistent low-resistance grounding protection against costly outages.

**Trade Mark*

HOW TO DRIVE DEEPER AND AT LOW COST



Equipped with a demountable steel framework supporting a Barco gasoline hammer, this truck is demonstrating that effective, low-resistance deep grounding can be accomplished in a simple, economical manner with Copperweld Sectional Ground Rods. You can readily duplicate this rig in your own shops. Complete plans will be mailed to you upon request.

Made by
COPPERWELD STEEL COMPANY
Glassport, Pa.



Stocked And Sold By:

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And All Their Distributors

how contractor
solved aluminum
cable problems in
new department
store installation

Oklip



aluminum!



During recent construction of the new Abraham & Straus department store near New York, The Johnson Electric Company made one of the first large scale installations of aluminum building wire.

Problems of possible galvanic corrosion, high resistance of aluminum oxide, cold flow of aluminum cable, etc., were overcome with Burndy Oklip connectors—made of high-conductivity cast copper alloy, suitably plated for use with either copper or aluminum cable, or on combinations of both. Simple new installation procedures—shown to engineers and foremen on the job—made sure of mechanically strong and electrically dependable connections.

Aluminum cable problems have been a major engineering project at Burndy for ten years. Whatever *your* electrical problem—when it involves connectors, Burndy can help you!

BURNDY

52-14

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ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . JULY, 1952

9

Find the Answer to Your Motor Problems Here ➡

ON THIS CHART YOU WILL FIND a standard type Allis-Chalmers motor to fit nearly every need from 1/2 hp up. Many of them have exclusive construction features, such as fin cooling and tube cooling, which offer you premium performance without premium price. Many times these features will enable you to improve your installation without adding to costs.

And, of course, modifications from strictly standard designs can easily be made to fit your particular requirements.

FREE HELP FROM EXPERIENCED APPLICATION ENGINEERS

If you have a special problem, Allis-Chalmers will gladly furnish experienced application engineers to help you work out your motor problems. Allis-Chalmers application engineers are particularly helpful because A-C's strong background in con-

ALLIS-CHALMERS Motors

trol, drives and many types of driven machines gives them an especially intimate knowledge of motor requirements.

When you have a problem involving motors—or any part of the machine from power line to driven shaft — call your nearby Allis-Chalmers District Office. In the meantime, send the coupon below for a complete booklet of motor types and characteristics.

SEND COUPON FOR FREE LITERATURE AND SELECTION CHARTS

Allis-Chalmers Manufacturing Company
Box 512, Milwaukee 1, Wisconsin

Please send me the following free literature to help me solve my motor and drive problems.

- ☐ Handy Guide to Electric Motors (51B6052)
☐ Handy Guide to Texrope Drives (20B6051)
☐ Across the Line Starters (14B7132)

Name _____

Company _____

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City _____

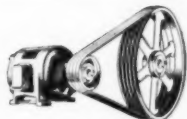
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A-3734

One Source for Complete Drive Unit



Control

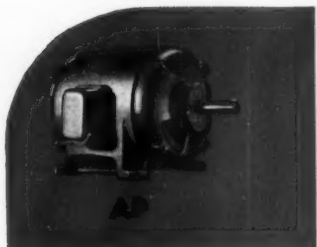


Motor

Texrope Drive

Engineered and built to work together. Your Allis-Chalmers District Office Representative can supply you with a complete, coordinated drive. You save selection time and are sure of dependable operation.

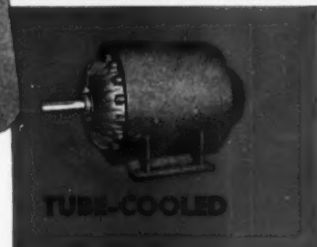
Texrope is an Allis-Chalmers trademark.



AP



APZ



TUBE-COOLED



GEAR MOTORS



FLANGE



VERTICAL

ALLIS-

RANGE

1/2 to 150 hp. 450 to 3600 rpm. 208, 220, 440, 550 volts. Frames 204 to 445 in AP construction. 504 and 505 in AW construction.

CONSTRUCTION

Stator yokes for AP motors are cast iron and have no bottom openings. AW motors are built with cast steel yoke heads, with integral mounting feet, and heavy continuous-welded steel drip covers. Stator

slots are semi-closed for the smaller sizes, open type with form-wound coils for the larger sizes. Windings are multiple dipped and baked. Rotors are cast aluminum with integral fans in frames 405 and smaller. Copper or copper alloy is used for larger ratings. Bearing end shields are cast iron. Ball bearings are available in all sizes. Sleeve bearings in some larger sizes.

MODIFICATIONS

Basic motor is open drip-proof rated

40°C continuous, NEMA Design B. Design C and D motors also are standard while Design A motors are considered special. Other electrical modifications available include 110 volts on frames 326 and smaller and 2300 volts on frames 445 and larger, and multi-speed motors with constant torque, variable torque and constant horsepower. Mechanical modifications include splash-proof rated 50°C continuous. Other modifications, both mechanical and electrical, can be made to suit your specific requirements.

RANGE

1/2 to 100 hp. 600 to 3600 rpm. 208, 220, 440, 550 volts. Frames 203 to 254 in non-ventilated construction. Frames 254 to 505 TEFC construction.

CONSTRUCTION

Special non-clogging design blows itself clean, is easy to wipe or blow off if oily or moist dirt sticks.

Fan-cooled and non-ventilated types have the same construction except that the fan-cooled motors have an external

fan and fan shield to circulate and direct air over the motor enclosure. Stator yoke is ribbed cast iron, designed for easy cleaning. Stator winding is the same as in open types. Bearing end shields are ribbed cast iron. Ball bearings are used except for 75 and 100 hp, 3600 rpm motors, which have split sleeve bearing construction.

Explosion-proof motors have extra deep rabbeted housing fits and bearing seals. All seals are metal to metal.

MODIFICATIONS

Basic motor is totally-enclosed, fan-cooled rated 55°C continuous, NEMA Design B. Design C and D motors also are standard while Design A motors are considered special. Same electrical modifications are available as in open types. Mechanical modifications include non-ventilated in smaller sizes and explosion-proof, both ventilated and non-ventilated, approved by Underwriters for Class I, Group D and Class II, Group F and G hazards.

RANGE

40 to 2500 hp. 600 to 3600 rpm. 208, 220, 440, 550 volts plus higher voltage in larger sizes.

CONSTRUCTION

Ventilating system is simple but highly efficient. The stator core is surrounded by a nest of tubes. Internal fans circulate the inside air around the tubes, while an external fan drives outside air through tubes to dissipate the heat. This arrangement permits full internal air circulation.

Cleaning is easy but seldom necessary. Stator yoke is heavy fabricated steel construction. Cooling tubes are generally copper but may be of other materials. Rotor construction is determined by speed, rating, and application. Bearing end shields are heavy cast iron, with internal and external ribs. Ball bearings are used except 3600 rpm, which have sleeve bearings. Explosion-proof motors differ from standard enclosed machines only in details.

MODIFICATIONS

Basic motor is totally-enclosed, fan-cooled

rated 55°C continuous, NEMA Design B. Design D and C motors also are standard while Design A motors are considered special. Same electrical modifications are available as in open types. Mechanical modifications include explosion-proof construction in all sizes approved by Underwriters for Class I, Group D and Class II, Group F and G hazards. Cooling tubes may be made of any material to withstand corrosive action of refinery vapors, fly ash, and other air-borne corrosives. This motor also available in vertical mounting type in all sizes.

RANGE

7.5 to 520 rpm with 1750 rpm motors. 1 to 50 hp. 208, 220, 440, 550 volts. Horizontal or vertical types.

CONSTRUCTION

Integral type uses round frame, D-flange motor, resulting in shorter overall length. All-motor type uses standard foot-mount-

ed motor—recommended whenever space permits. AGMA Class I, II, III gears for steady loads, moderate shock loads, and heavy shock loads respectively. Gears have compact, rigid, all steel housings. Large shafts, husky bearings and strong bearing mountings resist severe loading. Heat treated alloy steel helical gears are lubricated by direct dip for safe continu-

ous lubrication, protected by heavy duty shaft seals.

MODIFICATIONS

Any standard motor may be used with the complete range of mechanical and electrical modifications shown above. In addition, special designs can be built to meet special problems.

RANGE

1/2 to 150 hp. 450 to 3600 rpm. 208, 220, 440, 550 volts. Frames 203 to 505 in all constructions.

CONSTRUCTION

NEMA C face and D flange mounting construction is available in frames 505 and smaller in the same range of ratings as

the AP and AW types of motors shown at left, including mechanical modifications such as splash-proof and enclosed construction. Construction features and electrical modifications available are also the same as for the standard motors.

MODIFICATIONS

Flange motors may be supplied with or

without feet, as required. Round frame motors without feet include a special ventilating fan to supplement the regular rotor fans. The mounting face or flange may be obtained especially machined to fit specific applications at moderate additional cost. Motors may be mounted horizontally, vertically (except in certain cases) or at an angle.

RANGE

1/2 hp and up. 450 to 3600 rpm. 208, 220, 440, 550, 2300 and higher voltages. Frames 203 to 505 and up.

CONSTRUCTION

Vertical motors with NEMA type P bases

are available in the same range of ratings as the AP, AW, and AZ types shown at left, including mechanical modifications such as totally-enclosed and explosion-proof construction. Construction features and electrical modifications are same as for standard horizontal motors.

MODIFICATIONS

Special bearings for additional thrust carrying capacity are available in some cases. Where required special lubricating and grease retaining features are available.

CHALMERS

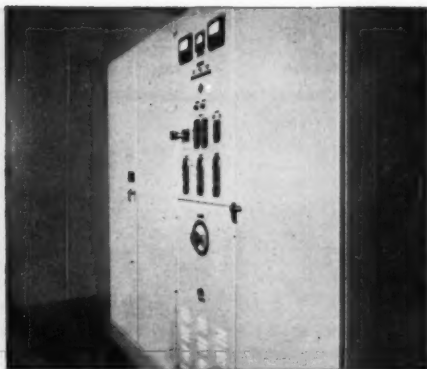


Whether Mine..

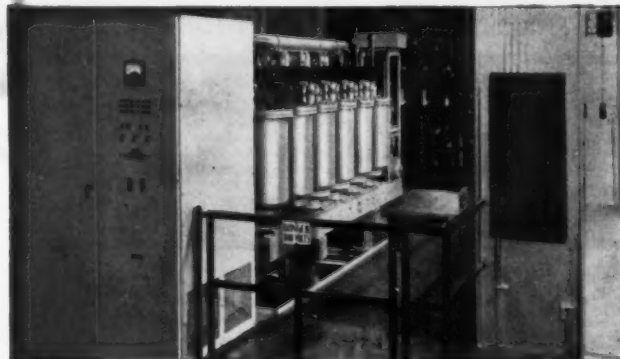
**ALLIS-CHALMERS MERCURY ARC RECTIFIERS WITH
EXCLUSIVE DESIGN FEATURES CAN SUPPLY YOUR DC NEEDS**



OUTSIDE view of one of five Allis-Chalmers rectifier substations serving the haulage system of a coal mining operation. Transmission line enters building at right, dc leaves at left. Entire substation can be moved as coal seams are exhausted, leaving only concrete slab behind.



INSIDE is the "dead front," factory packaged, 500 kw, 275 volt dc, sealed tube rectifier. Compartments are (L to R): for rectifier tubes, firing and auxiliary control, dc cathode breaker.



◀ **PUMP** evacuated rectifiers are applied in heavy duty service from 750 kw up. The 3400 kw, 500 volt unit seen here operates in parallel with steam turbine driven dc generators in the electrolytic reduction of metal.

SIDE view of pump evacuated rectifier at left, showing the centralized placement of auxiliaries — exclusively Allis-Chalmers. Both evacuation equipment and heat exchanger are accessibly placed at one end. ▶

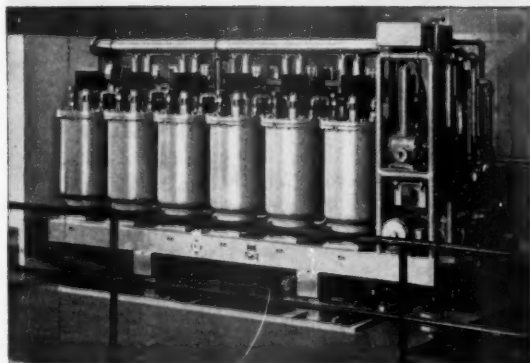
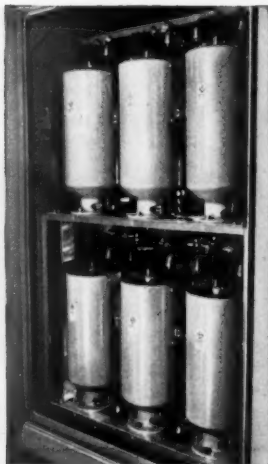
ALLIS-CHALMERS

Allis-Chalmers Engineers Introduced Mercury Arc Rectifiers to U.S. Industry

. or Mill!

ALLIS-CHALMERS MERCURY ARC RECTIFIERS

MODERN Allis-Chalmers design sealed tubes are located in the tube compartment. Other sealed tube units are supplied in ratings from 200 to 1000 kw.



WHEREVER DC IS NEEDED, from the mine to the mill, from the Elevated to the elevator, Allis-Chalmers rectifiers are quietly working away.

They combine the high efficiency, low maintenance characteristics of the mercury arc rectifier with exclusive A-C refinements in design and construction.

Factory packaged, light in weight, and requiring no special foundation, they can be placed right at the load center to cut dc feeder losses. Conversion efficiency is higher at all loads with large power savings during light load periods.

And in addition, only from Allis-Chalmers can you get rectifiers with these exclusive design refinements:

EXCLUSIVE ALLIS-CHALMERS FEATURES

- **Fixed excitation anode** — doesn't contact mercury and is independent of level, turbulence or impurities... requiring no adjustment, maintenance or replacement.
- **Continuous excitation** — pilot arc always present, eliminating need for continuous and synchronized re-ignition. Rectifier will ride through severe ac voltage disturbances.
- **Grid phase control** — in cooler and cleaner region near anode, where ion density is lowest.
- **Internal cooling system** — high heat transfer with seamless tube cooling coil located within the rectifier.
- **Arc-over-free tank** — eliminates danger of arcing-over to tank by insulating entire arc path.
- **Enamelled anode seals** — multi-layer fused vitreous construction provides high-strength seal, unaffected by thermal variation.

All these design advances are obtainable *only* from Allis-Chalmers. When you consider mercury arc rectifiers in your expansion or modernization planning, consider Allis-Chalmers.

For help with rectifier application and a fuller explanation of exclusive superior features, call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3681

10 Mercury Arc Rectifier Advantages:-

- ★ Compact and light weight
- ★ No special foundation
- ★ Push button starting with no synchronizing
- ★ Quiet operation with high power factor
- ★ Low idling loss and high conversion efficiency
- ★ High momentary overload capacity
- ★ Immunity to frequent short circuits
- ★ No moving parts, contributing to low maintenance cost
- ★ No attendance needed during operation
- ★ Resistant to dust, moisture, fumes
- ★ Simple construction with long life

ALLIS-CHALMERS Distribution Transformers



DISTRIBUTION transformers 100 kva and below. Typical of 2400 and 4800 volt classes.



DISTRIBUTION transformers 100 kva and below. Typical of 7200 through 14,400 volt classes.



DISTRIBUTION transformers 25 kva and below. Typical of 7200 and 7620 volt classes for grounded WYE operation with low voltage of 120/240.

ALLIS-CHALMERS Dry Type Transformer



LARGER CAPACITIES, single and three phase are ordinarily built for indoor operation, but can be supplied for outdoors on special order.



10 KVA and smaller, single phase; 30 kva and smaller, three phase. Wall mounted, indoors or out.

Get High Efficiency . . . Safety ... Low Maintenance ... Long Life

ALLIS-CHALMERS distribution transformers are built in one of the most modern plants in the industry and incorporate the latest developments for long life and low maintenance. Tank is of heavy gauge steel. Cold rolled electrical steel is used in cores to reduce size and weight. *Spra-Bonderizing* provides long lasting protection for the

tank surface. These are but a few of the many features.

Allis-Chalmers builds a complete line of transformers including protected (ACP Transformers) and conventional designs.

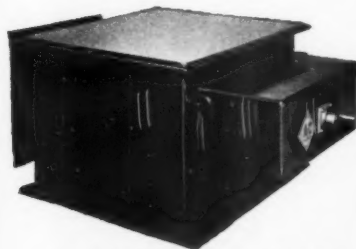
For more details, ask your nearby A-C District Office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

Cut Copper — Reduce

WHEN RELOCATING machinery, bring power close to the load with Allis-Chalmers dry type transformers. Secondary feeders are thereby kept short. This prevents efficiency losses due to under-voltage operation—saves on copper conductors. Shop men find these transformers small and easy to handle.

**Pioneers in Power and Electrical Equipment
from Generation through Utilization**

ALLIS-

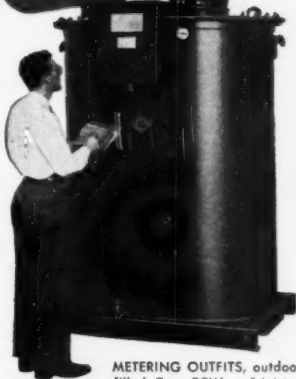


SEALED DRY TYPE transformer utilizes class H insulation materials. Gives complete protection against flooding, dusty or corrosive atmospheres, explosion and fire . . . ideal for hazardous industrial applications.



COMPACT CORE AND COIL. "Fiberglas" and other Class B insulating materials are used. Coils impregnated to make them impervious to moisture and protect against dirt.

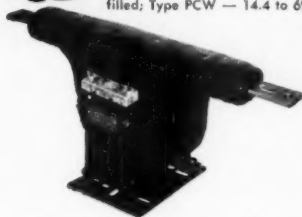
ALLIS-CHALMERS Instrument Transformers



INDOOR POTENTIAL, Type PD, fused or unfused; 200 VA up to 14,400 v.



METERING OUTFITS, outdoor — oil filled; Type PCW — 14.4 to 69 kv.



INDOOR CURRENT, for heavy duty metering; Types K2E — 8.7 kv, and K3E — 15 kv.



OUTDOOR POTENTIAL, Type SPW, for line-to-line operation. Standard ratings with standard insulation class ratings of 69 kv.

Requirements Power Losses!

In addition, simple clamp-type connectors speed hook-up time. They are a standard feature on 15 through 50 kva single phase and 37½ through 100 kva, three phase units. Case is *Spra-Bonderized*, triple-coated with baked-on paint. Ask your nearby A-C District Office for details, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

Over 400 Ratings Fit Most Design Needs

WHETHER YOU NEED metering outfits, or current or potential transformers, either indoors or out, you can get them from Allis-Chalmers. Uniformly high accuracy and liberal reserve thermal capacity are built-in qualities. Coils approximate the circular shape, prevent distortion under heavy overcurrents.

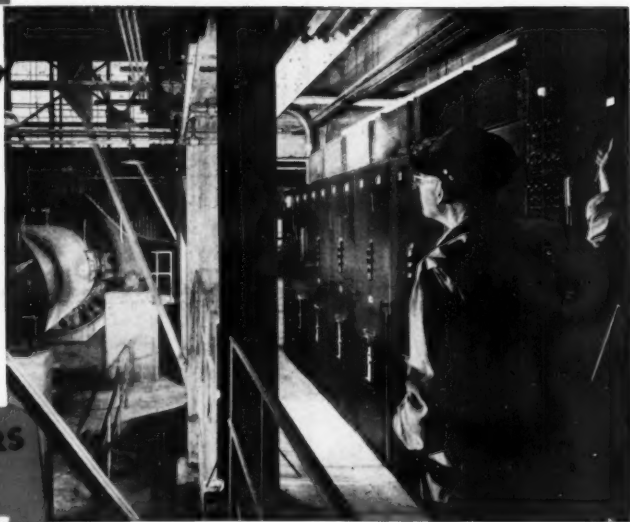
The Allis-Chalmers standard line fills practically every power need. Special designs built to meet unusual applications. For details call your nearby district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-3442C

CHALMERS



CONTROL

Engineered
for
specialized
industries



**ALLIS-CHALMERS
MOTOR
STARTERS**



LARGE BLOCKS OF CONTROLLED POWER are used in many highly specialized industries. For example, grinding silica sand into powder fine enough for use in lamp bases, dinnerware, bathroom fixtures, abrasive wheels — even porcelain finishes for appliances — is the job of six tube mills like this one. Turning the mills with their heavy loads of sand and flint pebbles takes the power of six 125-horsepower, 440-volt motors controlled by specially engineered starters.

A-3671



THESE STARTERS are designed to control the motors driving this high inertia load. They are full magnetic wound-rotor motor controllers. All the operator does is push the "start" button. Acceleration is automatic.

HEAVY DUTY RESISTOR BANKS in the motor secondary circuit cut down current inrush. Time delay relays allow the proper interval of time for each accelerating contactor to close and cut out resistance in successive steps.

WHEN 2500 TO 5000-VOLT lines are available, select Type H Starters for similar jobs. Current-limiting fuses, safety interlocks, meters, relays . . . everything needed for your application is built in. Ask for Bulletin 14B6410A.

ALLIS-CHALMERS



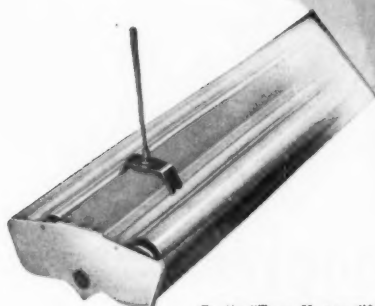
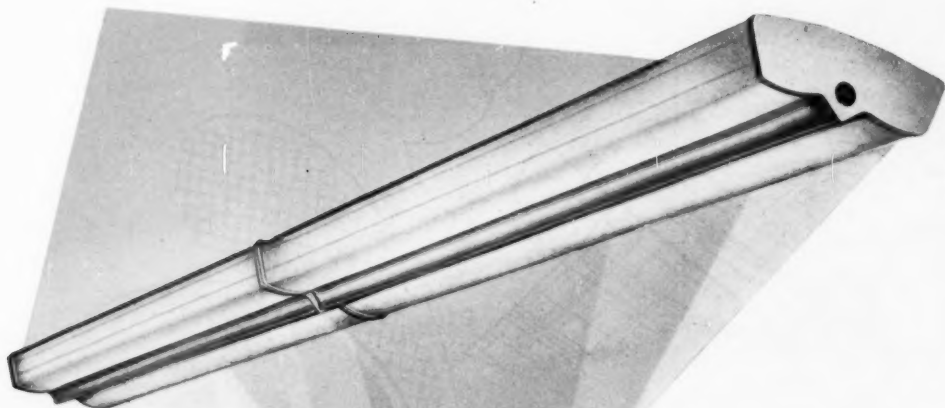
There are Allis-Chalmers controllers for use in every industry . . . starters for squirrel-cage, wound-rotor and synchronous motors. For starters to 2500 hp and up to 5000 volts — check with your A-C representative, or write Allis-Chalmers, Milwaukee 1, Wisconsin, for bulletins.

NEW

CURTIS

"EYE COMFORT"® 5000 SERIES

LUMINOUS INDIRECT FLUORESCENT LUMINAIRES



Curtis "Tong Hangers"* allow unlimited flexibility in placement of hangers and keep installation cost at a minimum.

*Pat. Applied For

APPROPRIATE BRIGHTNESS CONTROL

... quality lighting with comfortable brightness ratios providing ..

EYE COMFORT

... in seeing by scientific shielding, diffusing and distribution of the lamp light through ..

LOW BRIGHTNESS

... illumination that gives you lighting comparable to diffused daylight.

The new luminous indirect "Five Thousand" Series has Curtis quality construction and workmanship throughout... with wire channel constructed of heavy gauge steel finished baked white "Fluracite" enamel. Side panels are fine ribbed durable polystyrene plastic to softly diffuse the light and provide low-brightness ratios between the ceiling and luminaire. Curtis "Five-Thousand" Series luminaires are available to accommodate all 4', 5' and 8' fluorescent lamps. Write for descriptive literature.

Catalog Number	No. and Type of Lamps
5002	Two, 96", T-12, 72W Slimline
5003	Two, 48", T-12, 40W Bi-Pin Instant Start
5004	Two, 48", T-12, 36W Slimline
5005	Two, 60", T-17, 85W Bi-Pin Starter Type
5007	Two, 48", T-12, 40W Bi-Pin Starter Type
5008*	Four, 48", T-12, 40W Bi-Pin Starter Type
5009*	Four, 48", T-12, 40W Bi-Pin Instant Start
5010*	Four, 60", T-17, 85W Bi-Pin Starter Type

*Two Lamps Parallel.

CURTIS
LIGHTING, INC.

Dept. G 12-20

6135 W. 65th Street,
Chicago 38, Illinois

A WORKING GIANT

in a small package



There's always a call for a motor that will do a big job in a small amount of working space. And Hoover has it—in models that mean sales for distributors and dealers.

Starting torque to spin hard-to-start machinery into action without strain or vibration. *Running torque* to carry a steady or varying load smoothly—with reserve power to spare. And *stamina* to take the grind of long operating cycles or the daily punishment of frequent starts and stops.

Fully self-cooled as they run, and engineered to do away with drag or friction, Hoover Motors stay cool, quiet, reliable. Economical, too. Each watt of electricity gives its most in usable power.

And service? *When* it's needed, *where* it's needed. Hoover's service facilities are world-wide—always ready to protect your customers and to guard your good name.

THE HOOVER COMPANY

Kingston-Conley Division

65 Brook Avenue

North Plainfield, New Jersey

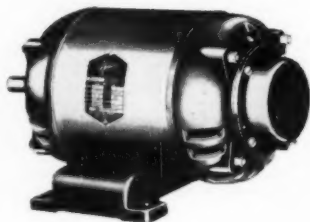
Hoover[®] electric motors

since 1934

Among Hoover's *general-purpose* motors, there are models that give distributors and dealers a widely varied line of *Capacitor-Start* and *Poly-Phase Motors*.

In *special-purpose* motors, too, there are Hoovers that will meet most of your customers' specifications "as is"—including models for pumps, oil burners, fans and blowers.

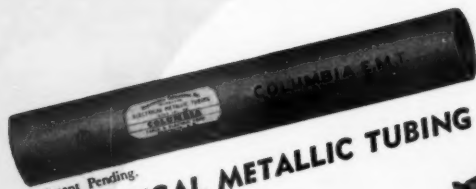
Write for descriptive literature and full information.



Specify-

COLUMBIA

ELECTRICAL PRODUCTS



Patent Pending.

ELECTRICAL METALLIC TUBING



A. B. C. ARMORED CABLE



FLEXIBLE STEEL CONDUIT



NON-METALLIC SHEATHED CABLE

All COLUMBIA electrical products are
Approved by Underwriters' Laboratories

Serving the Electrical Industry
Since 1912



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Sales Representatives in Following Cities:

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Detroit, Mich.
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Los Angeles, Calif.

Minneapolis, Minn.
New York, N. Y.
Philadelphia, Pa.

Portland, Ore.
San Antonio, Tex.
Seattle, Wash.

Spokane, Wash.
St. Louis, Mo.
Utica, N. Y.

**DOW CORNING
SILICONES**

give motors more muscles

Gained 30% more pumping capacity; saved about \$50,000

Engineers of a leading chemical company had to increase pumping capacity in one production unit by 30%. They did so by having 31 motors with name plate ratings of 50 and 60 hp at 850 rpm, rewound with Class H insulation to put out 75 to 90 hp at 1150 rpm.

New 75 hp motors with conventional insulation plus installation would have cost \$68,200. Rewinding, plus installation on the original mounts, cost about \$19,000. That's an initial saving of almost \$50,000.

Equally important has been the added life and reliability of these Class H motors. The old 50 and 60 hp motors burned out at the rate of one a month or 48 failures in 4 years. Rewound with Class H

insulation, these same motors have been delivering at least 50% more power for the past 4 years with only 6 failures.

That's why more and more engineers and management men specify Class H insulation for hard working motors, for critical motors that determine productive capacity, and for motors subjected to high ambient temperatures and excessive moisture or corrosive chemicals.

It has been proved over and over again that Class H insulation made with Dow Corning Silicones has 10 to 100 times the life expectancy of the next best class of insulating materials; can be used to increase the power per pound ratio in electric machines by as much as 50%.

mail this coupon *today*

Dow Corning Corp., Dept. G-19 Midland, Mich.

Please send me:

- ☐ Catalog of Class H Insulating Materials.
- ☐ List of Class H motor repair shops.
- ☐ Data on Silicone Grease for motor bearings.
- ☐ 32-page booklet entitled "What's A Silicone?"

Name _____

Company _____

Street _____

City _____ Zone _____ State _____

You can also reduce or eliminate motor outages due to bearing failure; specify Dow Corning 44 Silicone Grease for motor bearings.

In open and single shielded bearings designed for high temperature operation, Dow Corning 44 has 8 to 10 times the life expectancy of conventional greases. It gives life-time lubrication in permanently sealed bearings.

**DOW CORNING
Midland**

**DOW CORNING
SILICONES**

**CORPORATION
Michigan**

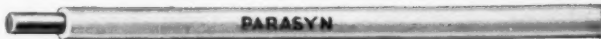
Atlanta • Chicago • Cleveland • Dallas • New York • Los Angeles • Washington, D. C.
In Canada: Fiberglas Canada Ltd., Toronto In England: Midland Silicones Ltd., London

IF IT'S PARANITE IT'S ^{the} RIGHT ^{Wire and Cable}

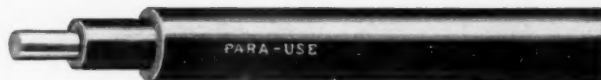
PARAFLEX Non-Metallic Sheathed Cable lays flat. Won't squirm or twist. Clean to handle. Plainly marked.



PARASYN Type TW Thermoplastic Wire stands exposure too severe for rubber insulated wires. Smaller diameter.



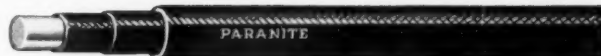
PARA-USE Type "RR" Cable provides permanent underground installation from power line to meter, and for connecting several buildings. Meets requirements of CAA Specifications L-824 as Type A (on all applicable sizes).



HYDRO-THERM Building Wire combines in a single wire the heat-resistant qualities of Type RH and the moisture resistant qualities of Type RW.



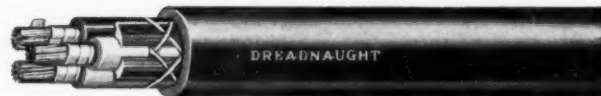
URC Weatherproof Wire and Cable can be relied upon to meet severe climatic conditions. Both actual line and Weather-Ometer tests prove unusual ageing characteristics.



SERVICE ENTRANCE CABLE, Type SE Style U unarmoured and Type SE Style A armoured. There is also a Paranite Service Drop Cable, two conductor, Type SD.



DREADNAUGHT Heavy Duty Cable has lead-cured neoprene insulation. Flexible, durable, safe, long-lived. Cuts repairs and replacements. Delivers current continuously.



IF IT'S **PARANITE** IT'S RIGHT!

DISTRIBUTED
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PARANITE WIRE AND CABLE
Division of ESSEX WIRE CORPORATION
FORT WAYNE 6, INDIANA

WIRES
AND CABLES
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WAREHOUSES AND SALES OFFICES: Atlanta, Ga.; Boston, Mass.; Chicago, Ill.; Cleveland, Ohio; Dallas, Texas; Detroit, Mich.; Indianapolis, Ind.; Kansas City, Mo.; Los Angeles, California; Miami, Fla.; New York, N.Y.; Philadelphia, Pa.; Portland, Ore.; San Francisco, California; San Jose, California; Seattle, Wash.; St. Louis, Mo.; Tampa, Fla.; Washington, D.C.; Wichita, Kan.

EXPORT SALES OFFICE—LIONEL-ESSEX INTERNATIONAL CORPORATION, 15 E. 26th ST., NEW YORK 10, N.Y.

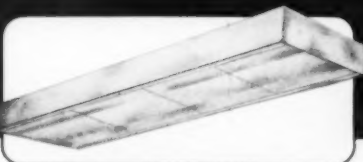
ELECTRICAL WIRES AND CABLES "BETTER THAN CODE REQUIRES"

Announcing...



A New
Feature-studded fixture by
LITECONTROL
... with Litecontrol's brand new
Snap-Lock Catch

Large illustration shows fixture with glass sides (Series 3600 Bi-pin, Series 3700 Slimline)



Smaller picture illustrates fixture as equipped with metal sides. (Series 3800 Bi-pin, Series 3900 Slimline)



Litecontrol's new snap-lock catch is opened with fingertip ease



To close just press door into place — the catch snap-locks itself

NOTEWORTHY for its extreme shallow depth — only 4" — this new LITECONTROL fixture makes an exceptionally good appearance... unobtrusively.

Holophane® No. 9016 Low Brightness Lenses are set in a hinged door. The door is equipped with LITECONTROL's special new snap-lock catch... opened by easy fingertip pressure on protruding catch-trigger, closed by simply pushing into place where it snaps into closed-and-locked position automatically.

Low Brightness Lenses hold the brightness down at critical viewing angles. A variety of effects may be achieved by using different side panels — diffusing glass, plastic or all-metal.

Cat. No.	No. & Type of Lamps	Width	Height	Length
3624	2-40 Watt Bi-pin	12"	4"	48 1/4"
3724	2-48T12 Slimline	12"	4"	48 1/4"
3726	2-96T12 Slimline	12"	4"	96 3/4"
3824	2-40 Watt Bi-pin	12"	4"	48 1/4"
3924	2-48T12 Slimline	12"	4"	48 1/4"
3926	2-96T12 Slimline	12"	4"	96 3/4"

Write for full details today!



LITECONTROL

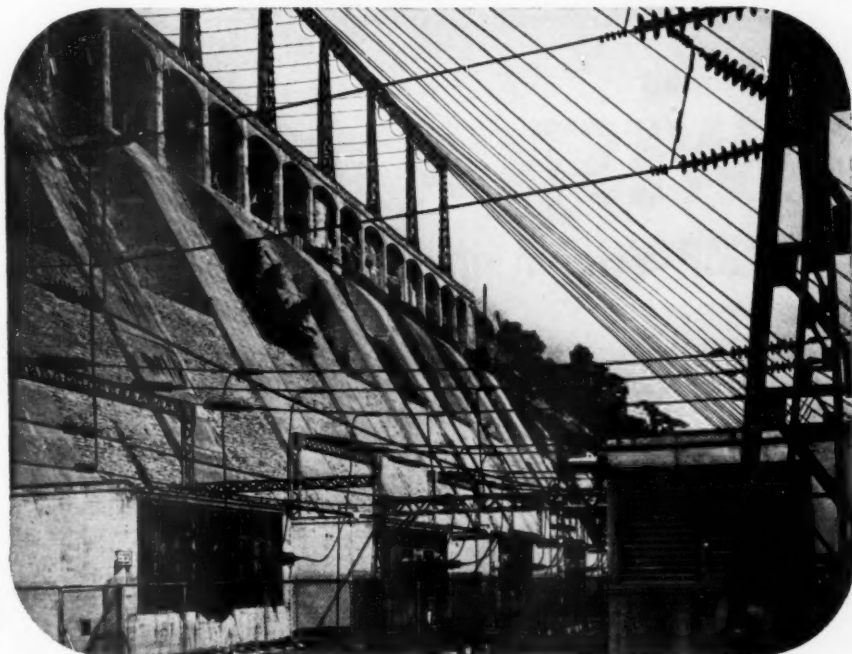
Fixtures

KEEP UPKEEP DOWN

LITECONTROL CORPORATION
36 Pleasant Street, Watertown 72, Massachusetts

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

V. C. CABLE



Specify Roebling V. C. Cable for top resistance to heat, oil and grease

THROUGH continual laboratory developments and progressive manufacturing methods, Roebling Varnished Cambric Cable has been constantly improved. Today this cable has absolutely top resistance to heat, oil and grease . . . and it's the most dependable cable you can use for leads on generators, transformers, motor and oil switches, and for general distribution of heavy power loads in manufacturing and industrial plants.

Roebling V.C. is made in single conductor sizes

from 2,000,000 C.M. to #14 A.W.G.; in multiple conductor sizes from 750,000 C.M. to #14 A.W.G. Recommended for use to 17,000v between phases in single or multiple conductor construction; and to 26,000v for single conductor grounded neutral.

Large quantities of Roebling's complete wire and cable line are now required for rearmament. We and our distributors will, however, do all that we can to meet your needs. John A. Roebling's Sons Company, Trenton 2, N. J.

ROEBLING

ATLANTA, 934 AVON AVE • BOSTON, 51 SLEEPER ST &
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• CINCINNATI, 3253 FREDDONIA AVE • CLEVELAND, 701
ST. CLAIR AVE, N. E. • DENVER, 4801 JACKSON ST •
DETROIT, 915 FISHER BLDG • HOUSTON, 4516
NAVIGATION BLVD • LOS ANGELES, 9340 E.
HARBOR ST & 120 S. HEWITT ST • NEW YORK, 19
RECTOR ST • ODESSA, TEXAS, 1920 E. 2ND ST
• PHILADELPHIA, 230 VINE ST • PITTSBURGH
1301 CLARK BLDG • ROCHESTER, 1 FLINT ST
• SAN FRANCISCO, 1740 17TH ST •
SEATTLE, 900 1ST AVE S. • ST. LOUIS,
3301 DELMAR BLVD • TULSA,
331 N. CHEVENE ST •
EXPORT SALES OFFICE,
TRENTON 2, NEW JERSEY



IT PUTS THE **SQUEEZE** ON MAINTENANCE COSTS!

WESTON MODEL 633 CLAMP VOLT-AMMETER

A-C Current—five full scale ranges of 1000/250/100/25/10 amperes, with range overlap for good readability. Measurements under 10 amperes readily obtained.

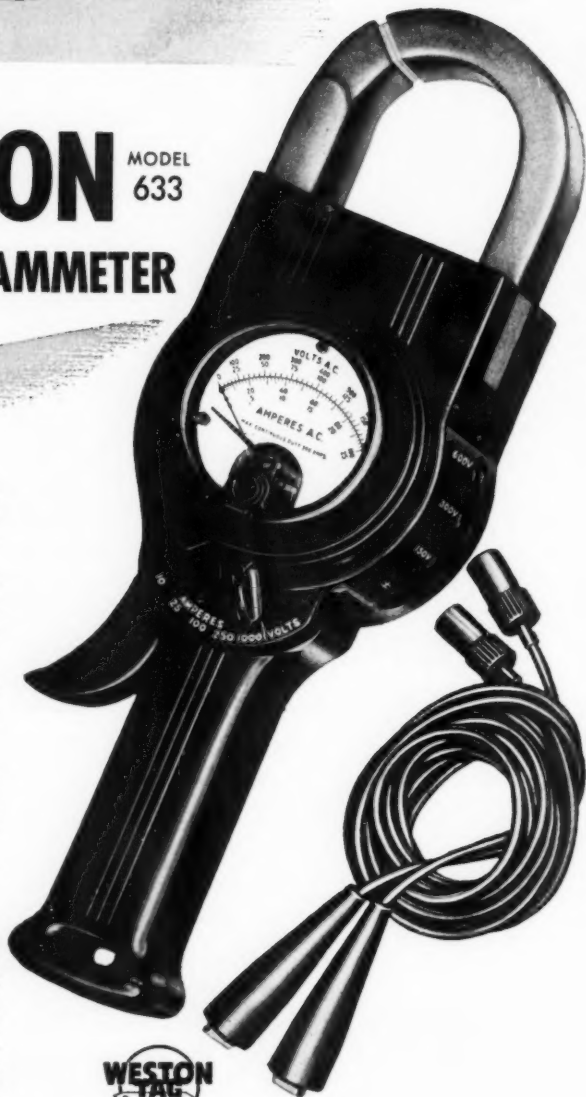
A-C Voltage—three self-contained ranges of 700/350/175 volts insure accurate readability, in the upper half of the scale. Instrument insulated for 750 volt service.

Isolated Voltage and Current—with circuits insulated from each other, instrument can be connected to both voltage and current sources at same time.

Convenient 6 position switch—easily operated with gloved hand, a flick of the thumb selects any of the 5 current ranges, or the Volts position.

Adjustable pointer stop—red stop facilitates measuring starting current of motors.

Here's the instrument that produces big savings by slicing hours off maintenance schedules . . . produces worth-while revenue by forestalling costly repairs and shutdowns. Being so quick and simple to use, scheduled maintenance measurements are made more accurately . . . and trouble-shooting is simple and sure. Built to WESTON standards of safety, accuracy and dependability. Also available for A-C Ampere measurement only. Order through your local representative, or write . . . WESTON Electrical Instrument Corporation, 617 Frelinghuysen Avenue, Newark 5, New Jersey . . . manufacturers of Weston and Tagliabue instruments.



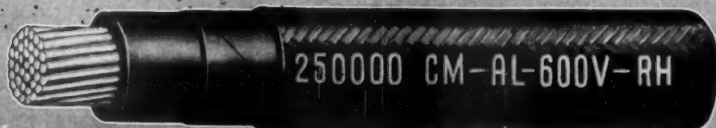
WESTON *Instruments*

9238

. . . TO INDICATE—RECORD—CONTROL

*If You Need Quicker Delivery
on Large Size Cable*

USE ALUMINUM



AN EXCELLENT ALTERNATE FOR COPPER

BULLETIN No. 521

CRESCENT Aluminum Building Wire



ALUMINUM is a good alternate for copper for the conductors in Building Wire and Cable. Aluminum conductors, particularly in the larger sizes, will show a substantial saving in total per conductor of equal circuit capacity in many cases, as compared with copper.

CRESCENT Aluminum Building Wire is made with ENDURITE Heat-Resistant insulation in sizes number 4 A.W.G. to 1,000,000 CM at 60-75° C. and 60-75° F.

Aluminum has long been used for electrical conductors. Bare transmission lines of aluminum have been used for over forty years under all types of atmospheric conditions. Aluminum is used for heavy bus conductors and is preferred for the purpose in the electrical industry because of its ability to withstand the highly corrosive conditions which are prevalent in this industry. In fact, even electric generating plant aluminum has been in use with the utmost satisfaction since 1920 and they appear as though they could be used indefinitely. Aluminum building wire has been used satisfactorily in lengths for many years in the present satisfactory service.

UNDERWRITERS' LABORATORIES APPROVAL

In August, 1935 the Underwriters' Laboratories issued a special bulletin instructing their inspectors to accept on and after September 1, 1935 aluminum conductors, No. 12 A.W.G. and larger in the standard types of building wire. The Underwriters' Laboratories label for A.C. wire will be placed on all types of wire on the material tags as well as in the printing on the surface of the wire, so that the aluminum wire can be identified readily. Material tags will be of a special color for your easy identification of the aluminum conductors.

CRESCENT has had much experience in the manufacture of insulated aluminum conductors. CRESCENT ALUMINUM Building Wire employs ENDURITE heat and moisture resistant insulation in sizes No. 1/0 A.W.G. to 1,000,000 CM as Underwriters Laboratories "TYPE RH-75° C. or RW-60° C."

CRESCENT ALUMINUM Service Cables are available in size No. 6 A.W.G. and larger as Service Drop (Type SD); Service Entrance (Type SEU); or Underground (Type USE, style RR).

CRESCENT ALUMINUM Power Cables can be furnished with rubber, thermoplastic or varnished cambric insulation and with braid, neoprene jacket, lead or armored coverings. We will welcome your specific inquiries.

Under the C.M.P. Program, it is necessary to get an allotment of aluminum for insulated electrical cables from your Claimant Agency.

Your Electrical Distributor and the CRESCENT Sales Representative will be glad to work with you in obtaining additional desirable aluminum cable above what you can get in the critically short copper types.

*Send Now For Bulletin No. 521
It Gives Complete Information*



CRESCENT



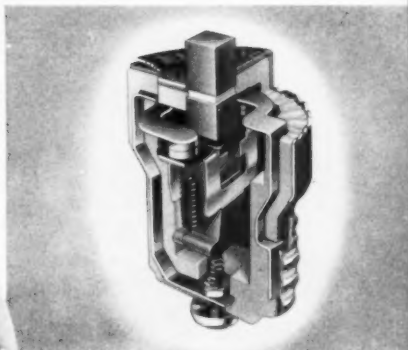
WIRE & CABLE
CRESCENT INSULATED WIRE & CABLE CO.

TRENTON, N. J.

Introducing


MINI

... the amazing



This is **MINI-BREAKER**—compactly designed, precision engineered, and individually tested after assembly to assure permanent trouble-free circuit breaker protection!

-BREAKER[®]

new miniature circuit breaker that fits like a fuse in any standard plug-type fuseholder!

NEVER before has there been a circuit protective device quite like the amazing new MINI-BREAKER. Because here, for the first time, is a thoroughly tested miniature branch circuit breaker that can actually be used as a *direct replacement* for expendable plug-type fuses! Installed by anyone in a matter of seconds in any standard Edison base fuse receptacle. Used with confidence, too, wherever 15, 20 and 30 ampere circuits exist for 110-125 volt a-c service. For although many attempts have been made to develop just such a practical low-cost device, MINI-BREAKER is the first and only product of its kind ever to meet the requirements specified for listing as a "Circuit Breaker-Miscellaneous" by Underwriters' Laboratories, Inc. And, when commercially available, it will bear the Re-examination Service marker.

Provides Permanent, Positive Protection Against Overloads and Short Circuits!

Yes, in spite of its compact size and its basic resemblance to the fuse it is designed to replace, MINI-BREAKER is a full-fledged circuit breaker in every sense of the term. A precision built assembly of carefully selected, perfectly balanced parts . . . all permanently protected and enclosed within a durable insulating case.

In operation, MINI-BREAKER safely interrupts excessive overloads and short circuits . . . tripping instantly on "shorts", but with a built-in time lag for handling temporary starting loads and line surges. Whenever an interruption occurs, service can easily be restored by anyone . . . normally within 10 seconds . . . simply by pressing in and releasing the reset button. Yet, in spite of its quick recovery, MINI-BREAKER is 100% trip-free. That is, it positively will not maintain a circuit that has not been cleared of the condition that caused the interruption.

What's more, while MINI-BREAKER is a thermally actuated breaker, it's virtually unaffected by the changes in ambient temperatures encountered under normal installation conditions. Because, although designed exclusively for ordinary residential, commercial, and industrial service, MINI-BREAKER actually meets and exceeds the temperature extreme conditions required for approval for aircraft use. MINI-BREAKER trips at 200% load within four minutes at -50°F., carries rated current continuously at 135°F.!



Anyone can install a MINI-BREAKER in seconds! And anyone can restore electrical service simply by pressing and releasing the reset button!

What can MINI-BREAKER do for an Electrical Contractor? Or a Maintenance Superintendent? Plenty! No more fussin' with blown out fuses, no more "down time" or costly interruptions of electric service. Instead, MINI-BREAKER provides modern, dependable, permanent circuit breaker protection at a new low in cost. It presents a vast new modernization market, too. A market that can't be reached by conventional circuit breakers due to the cost of conversion installation.

MECHANICAL PRODUCTS, INC.

1824 River Street • P. O. Box 116 • Jackson, Michigan

Want More Information on MINI-BREAKER?

Regardless of what your interests may be, we'd like to tell you more about MINI-BREAKER. A request on your company letterhead . . . or the coupon below . . . will bring you complete details by return mail.



MECHANICAL PRODUCTS, INC.—Dept. 103

Gentlemen:

Please send me the complete MINI-BREAKER story at once!

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

**"STARTING LOAD ON OUR
40 H. P. CRUSHER MOTOR
CAUSED 400 AMP. ORDINARY FUSES
TO BLOW... BUT NOW 125 AMP.
FUSETRON FUSES LET MOTOR
START AND GIVE BURNOUT
PROTECTION TOO."**

Mr. Meeka explains...

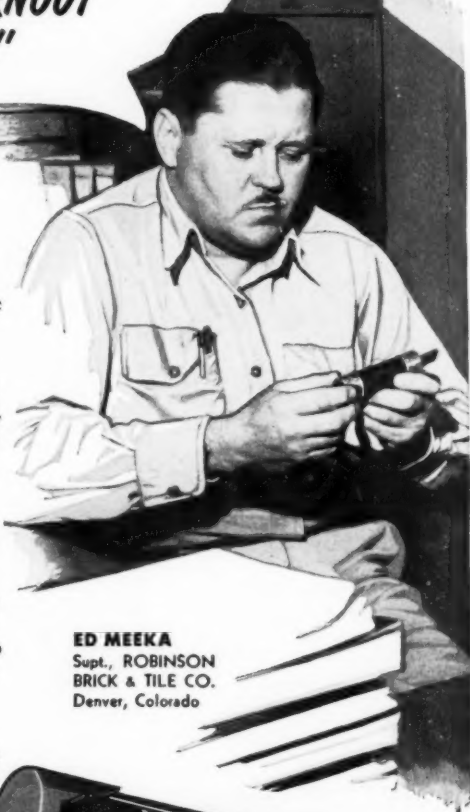
"We have a crusher driven by a 40 h.p. 250 volt motor. The starting load on this motor is often quite heavy and gave us no end of trouble by causing the 400 ampere fuses protecting the circuit to blow.

"Some months ago, after checking the actual running current of the motor with an ammeter, we decided to see if FUSETRON dual-element Fuses could live up to their claims.

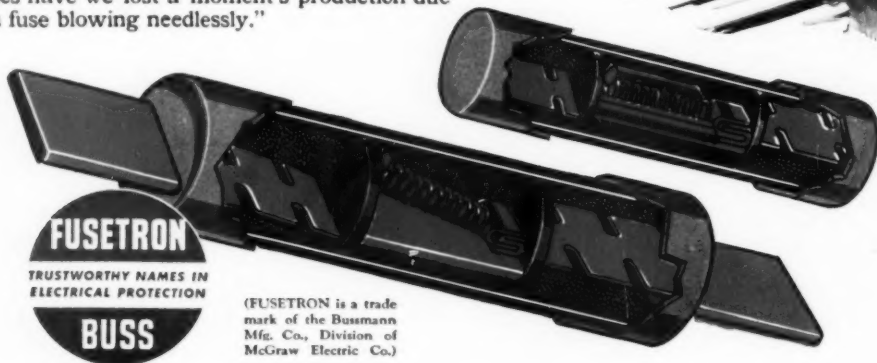
"The ammeter reading indicated that 125 ampere FUSETRON Fuses should be used to give motor-running protection. So, we installed this size.

"Were we surprised—they not only hold the starting current of the crusher motor—but we have the satisfaction of knowing the motor also has burnout protection to back up the overload relays in case they should ever fail.

"Not once since we installed FUSETRON Fuses have we lost a moment's production due to a fuse blowing needlessly."



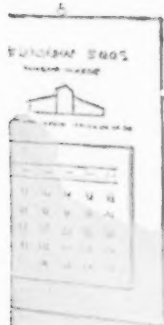
ED MEEKA
Supt., ROBINSON
BRICK & TILE CO.
Denver, Colorado



FUSETRON
TRUSTWORTHY NAMES IN
ELECTRICAL PROTECTION
BUSS

(FUSETRON is a trade
mark of the Bussmann
Mfg. Co., Division of
McGraw Electric Co.)

**"FUSETRON FUSES NOT
ONLY ELIMINATE USELESS
SHUTDOWNS - THEY GIVE
YOU 10 POINT
PROTECTION."**



- 1 Protect against short-circuits.*
- 2 Protect against needless blows caused by harmless overloads.
- 3 Protect against needless blows caused by excessive heating—lesser resistance results in much cooler operation.
- 4 Provide thermal protection—for panels and switches against damage from heating due to poor contact.
- 5 Protect motors against burnout from overloading.
- 6 Protect motors against burnout due to single phasing.
- 7 Give DOUBLE burnout protection to large motors—without extra cost.
- 8 Make protection of small motors simple and inexpensive.
- 9 Protect against waste of space and money—permit use of proper size switches and panels.
- 10 Protect coils, transformers and solenoids against burnout.

*Fusetron Fuses have high interrupting capacity as shown by tests of the Electrical Testing Laboratories of New York City in December 1947.

DON'T RISK LOSSES

One **needless** shutdown . . .
One **lost** motor . . .
One **destroyed** switch or panel
One **burned out** solenoid . . .

May cost you far more than replacing every ordinary fuse with a Fusetron dual-element Fuse.

MAIL THE COUPON NOW

for complete information about the All-Purpose Protection of
FUSETRON
Dual-Element FUSES.

BUSSMANN Mfg. Co. (Division of McGraw Electric Co.)
University at Jefferson, St. Louis 7, Mo.

Please send me complete facts about FUSETRON dual-element Fuses.

Name

Title

Company

Address

City & Zone State **ECM-7-52**

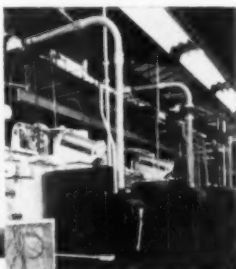


ELECTRUNITE "Inch-Marked" E.M.T., the modern lightweight rigid steel electrical raceway, is approved by the National Electrical Code for concealed, exposed, and concrete-slab installation.

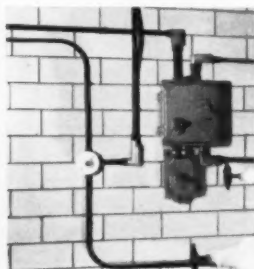
The last word in modern living, this luxury apartment building is wired throughout with ELECTRUNIT E.M.T., the raceway that provides the mechanical protection of steel and an emergency electrical path to ground for protection of life and property.



Round-the-clock reliability of hospital electrical facilities is assured by enclosing power circuits, call systems, and fire alarm wires within the steel walls of ELECTRUNIT E.M.T.



Flexibility of power supply circuits is important in factories. Economical ELECTRUNIT E.M.T. is easy to install, easy to relocate.



Extra-severe corrosive conditions in industrial plants no longer make periodic replacement of raceways necessary. *New*, ELECTRUNIT "Dekoron-Coated" E.M.T. is protected by an impervious plastic armor. Write for literature.

REPUBLIC STEEL CORPORATION

STEEL AND TUBES DIVISION

224 EAST 131st ST. • CLEVELAND 8, OHIO



"Inch-Marked" E.M.T., plus the handy ELECTRUNITE Bender takes the guesswork out of bending raceways . . . makes work easier on all types of jobs.



ELECTRUNITE E.M.T. helps install the hard ones easier . . . no threads to cut, no long runs to turn, no bare metal exposed . . . quick, moisture-tight connections are made with handy compression fittings.

CONTRACTORS HAIL MULTI-PURPOSE RACEWAY...

Electrunite E.M.T. makes jobs go in easier

For a supermarket or a school, in Manhattan or Cement, Oklahoma, large contractors and one-man firms install more ELECTRUNITE E.M.T. than any other brand of E.M.T. Here's why . . .

The "Inch-Marked" feature, available only on ELECTRUNITE E.M.T. makes it easy to cut and bend this light-and-strong raceway accurately. Jobs go in on schedule and neatly.



Other features that contractors and electricians like are exclusive *inside-knurling* for easier wire-pulling . . . compression fittings for rapid, moisture-tight, threadless connections . . . high strength with light weight . . .

★ ★ ★

And for extra-severe corrosive conditions, use *new, exclusive* ELECTRUNITE "Dekoron-Coated" E.M.T. . . . it's plastic-armored to give years more service against severe corrosive conditions.



LIGHTWEIGHT THREADLESS RIGID STEEL RACEWAY

TOMIC SALES & ENGINEERING CO.

4864 Woodward Ave.

Detroit 1, Michigan

Do the Job

BETTER, EASIER, FASTER with



TOMIC FITTINGS



Pat. No. 2458276

TOMIC THINWALL CONNECTORS

No. 10— $\frac{1}{2}$ " • No. 11— $\frac{3}{4}$ " • No. 12—1"

No crimp, no screw, no wrench . . .

Just tap or push it on

Interior stainless steel washer holds tubing securely—makes uniform, safe, permanent vibration-proof 6-point ground around entire tube. OK in concrete slabs. Smooth raceway. Perfect for cramped or corner locations.



Patent No. 2458276

TOMIC THINWALL COUPLINGS

No. 310— $\frac{1}{2}$ "
No. 311— $\frac{3}{4}$ " • No. 312—1"

Screws in on straightaway jobs . . . snaps in on corner jobs. No tools needed. Cannot shake loose. Versatile . . . change from heavy pipe to Thinwall and vice versa. Can be used to go from Thinwall to Greenfield. Easy to install. Easy to inspect.



Patent Nos. 2097695 and 2419426

TOMIC CABLE CONNECTORS

No. 100 Romex® Connector for $\frac{1}{2}$ " K.O.

No. 200 Service Entrance and Range Cable Connector for $\frac{3}{4}$ " K.O.

Installed from the outside of the box . . . with no locknuts to lose or fumble with. Fits in quickly and easily. Handles new and old type non-metallic sheathed cable. Makes the job easier, safer, better.



Pat. Applied For

Catalog No. 90

TOMIC 2 in 1 BOX HOLDER or FIXTURE HOLDER

For concrete work—prevents lost boxes, eliminates shifting, keeps box clean . . . all but centering clamp reclaimable, hangers can be used again and again. Used as a fixture hanger, it's quickly and easily installed on deck—has ample thread allowance for all conditions. Provides fixture mounting studs away from outlet boxes.



TOMIC FIXTURE EXTENSIONS

No. 1— $\frac{3}{8}$ x $\frac{3}{8}$ x $\frac{3}{8}$ "
No. 2— $\frac{3}{8}$ x $\frac{3}{8}$ x 1"
No. 3— $\frac{3}{8}$ x $\frac{3}{8}$ x 1 $\frac{3}{8}$ "

Machined from bar stock. Knurled shoulder. Clean threads.

IMMEDIATE DELIVERY—WRITE FOR SAMPLES

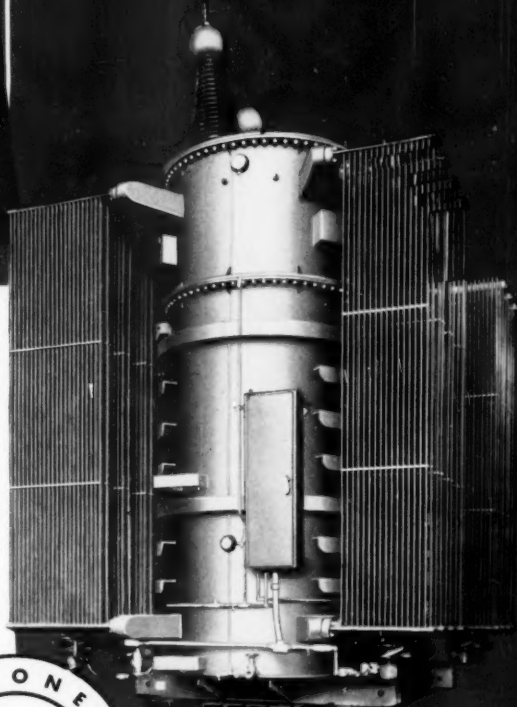
MOLONEY PRODUCTS

These pages describe and illustrate the products of the Moloney Electric Company. For further information address your inquiry to nearest Sales Office or write direct to Moloney Electric Company.

POWER TRANSFORMERS

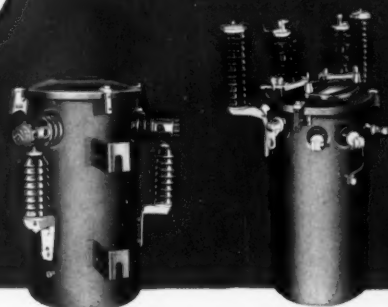
The Moloney Electric Company manufactures Power Transformers of any voltage rating or capacity desired. Standard designs offer saving on single-phase ratings up to 5000 Kva and three-phase ratings up to 10,000 Kva in voltages from 2400 to 67,000 volts. These standard designs also permit quicker deliveries as a result of savings in engineering time.

Power Transformers may be furnished with Askarel (non-inflammable cooling liquid) for use in locations where the use of oil might constitute a hazard.



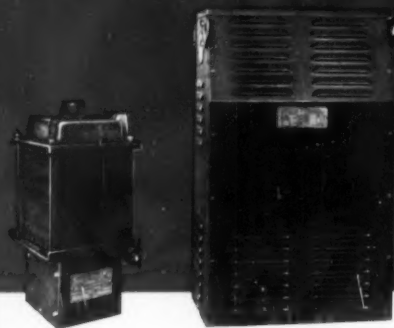
CONVENTIONAL DISTRIBUTION TRANSFORMERS

Manufactured in all standard single-phase and three-phase ratings up to 500 Kva in voltages of 67,000 volts and below. HiperCore construction on sizes up to 100 Kva, 15,000 volts and below, permits smaller size, lighter weight, increased efficiency and better regulation. Illustrated, small single-phase HiperCore Transformers. Distribution transformers are provided with standard taps and accessories in all ratings in accordance with ASA and NEMA standards.



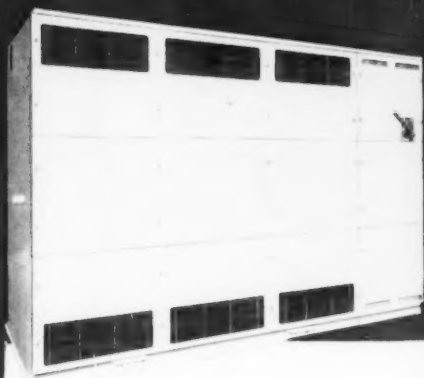
CSP DISTRIBUTION TRANSFORMERS

Completely Self-Protected (CSP) Transformers manufactured in ratings up to 100 Kva, single-phase, and up to 150 Kva, three-phase, in voltages below 15,000 volts. Equipment includes tank-mounted lightning arresters, internal primary protective links, tank grounding gap and secondary circuit breaker. Signal lights provided on all sizes 5 Kva and larger to indicate overload conditions. Signal light remains on till the circuit breaker is reset even though the overload may be of insufficient magnitude to trip the breakers.



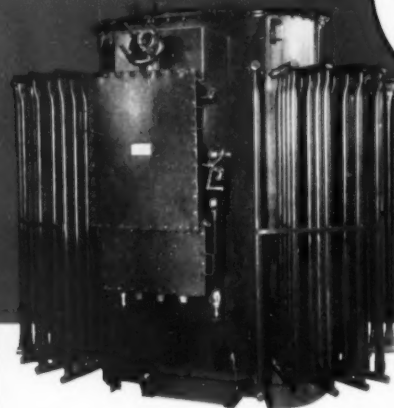
DRY-TYPE, AIR-COOLED TRANSFORMERS (600 volts and below)

Moloney Dry-Type Transformers with primary voltages of 600 volts and below are manufactured in standard single-phase and three-phase ratings from 1.5 Kva to 300 Kva. 1½ to 10 Kva single-phase transformers are of Type DS weatherproof construction as illustrated at left. 15 to 150 Kva single-phase transformers are of Type DC construction as illustrated at right for indoor service only. Three-phase units are not illustrated here.



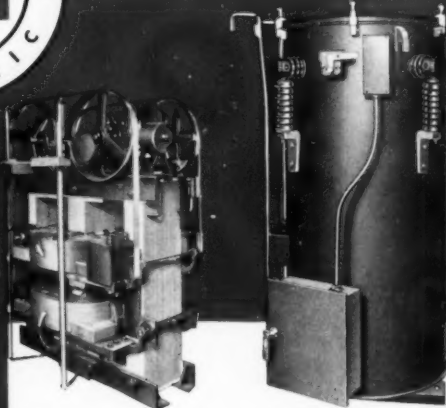
DRY-TYPE, AIR-COOLED TRANSFORMERS (2400 volts and above)

Moloney Dry-Type Transformers with primary voltages of 2400 volts or higher are made with Class B insulation (80° C. rise). Because of the absence of a cooling liquid, there is practically no maintenance cost when using air-cooled transformers. There is no liquid to require testing and conditioning and no valves, gaskets, or cooling tubes to maintain. Dry-Type Transformers are limited to a maximum voltage of 15,000 volts and to a maximum size of approximately 3750 Kva.



ASKAREL TRANSFORMERS (Non-Inflammable—Liquid-Cooled)

Askarel Transformers contain a non-inflammable cooling and insulating liquid. This permits installation indoors without the expense of a fireproof vault. Their weatherproof construction also permits outdoor installation such as on roofs of buildings, in sidewalk vaults, in mines, and in other locations where the presence of oil-filled transformers might constitute a hazard. Askarel Transformers are available in the same ratings as oil-cooled transformers.



CONSTANT CURRENT TRANSFORMERS (Including Packaged Units)

Moloney Constant Current Transformers are designed for use on series street or highway lighting circuits. They are available in Pole, Subway and Station Types.

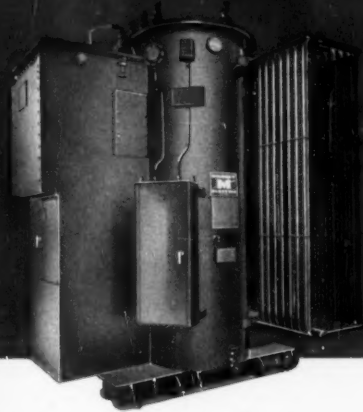
Packaged Unit Constant Current Transformers are oil-cooled units for pole or platform mounting, which are equipped with complete, built-in, protective and control equipment.

All constant current transformers may be supplied with built-in capacitors for power factor correction.



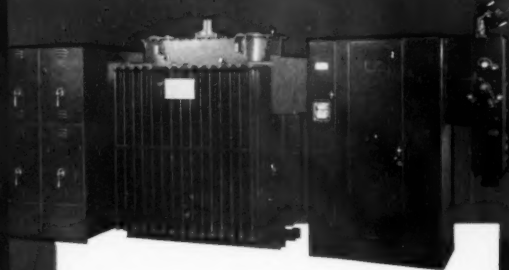
FEEDER VOLTAGE REGULATORS AND REGULATING TRANSFORMERS

Moloney Feeder Voltage Regulators and Regulating Transformers provide excellent voltage regulation through use of the Moloney Load Tap Changer. 10% plus and minus voltage regulation is provided in either 32- $\frac{1}{2}$ % or 16-11 $\frac{1}{4}$ % steps. Operation of the Load Tap Changer equipment on Feeder Voltage Regulators is completely automatic. Regulating Transformers can be arranged for either automatic control or remote-manual control, or a combination of the two.



LOAD RATIO CONTROL TRANSFORMERS

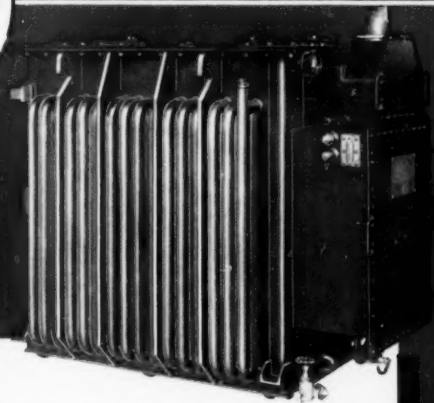
Power Transformers of all sizes are available with Load Ratio Control Equipment to maintain uniform voltage at the load by changing the voltage ratio without interruption of service. The Load Ratio Control mechanism is enclosed in an oil-filled compartment separate from the main transformer tank. The associated control equipment is housed in a dust-proof housing separate from both the main tank and the LRC mechanism compartment. Controls may be either automatic, remote-manual, or both.



LOAD CENTER UNIT SUBSTATIONS

Load Center Unit Substations are available for either indoor or outdoor installation. Indoor types available with either air-cooled or Askarel-cooled transformers. Outdoor types available with either oil-cooled or Askarel-cooled transformers. Substations can be supplied with various arrangements of switches, fuses and low voltage switchgear.

Liquid-cooled units can be provided with Automatic Load Ratio Control equipment to maintain a uniform voltage under varying load conditions.



NETWORK TRANSFORMERS

Network Transformers are available in Submersible and Vault Types and with either oil or Askarel as the insulating and cooling liquid. These are compactly built transformers which take up a minimum of space in underground vaults.

Standard three-pole, three-position disconnecting and grounding switches permit isolating the transformer from the primary circuit. The low voltage end of the transformer is provided with a throat for attaching a network protector.



SUBMERSIBLE DISTRIBUTION TRANSFORMERS

Designed for underground service. Their construction permits operation while submerged for long periods of time. Wiping sleeves are provided for connection of lead-covered cables. The cover is solidly welded to the tank to insure a watertight transformer. Tanks and cooling tubes, provided on the larger sizes, are of heavy gauge metal to withstand the rigors of underground service.



CAPACITORS

Moloney Shunt Capacitors correct low power factor conditions by reducing reactive Kva. Improved power factor results in more efficient use of generator, transformer and feeder line capacity, and improves voltage regulation.

Individual capacitor sections are wound of aluminum foil and pure kraft insulating paper. Complete capacitors are vacuum-filled with Askarel, a non-inflammable insulating liquid. Solder seal bushings are provided on all Moloney Capacitors to prevent entrance of air or moisture. Standard ratings 15 and 25 Kvar, from 2400 to 13,800 volts.



MOLONEY ELECTRIC COMPANY

Manufacturers of Power Transformers • Distribution Transformers • Load Ratio Control Transformers • Step Voltage Regulators • Unit Substations

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Amarillo, Tex. 616 Amarillo Bldg.
Anderson, S. C. 460 Tribble St.
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Birmingham, Ala. 1814 First Ave., North
Bluefield, W. Va. 2400 Fairfield Ave.
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Buffalo 3, N. Y. 564 Ellicott Square Bldg.
Butte, Montana 604 Utah Ave.
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Jacksonville, Fla. 3323 Timuquana St.
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Knoxville 17, Tenn. 1243 N. Broadway
Los Angeles 13, Calif.
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Memphis, Tenn. 1352 Madison Ave.
Minneapolis 1, Minn. 632 Midland Bank Bldg.
New Orleans 15, La. 4018 Thalia St.
New York 5, N. Y. 55 Liberty St.
Omaha 2, Nebr. 1104-5 WOW Bldg.
Philadelphia, Pa.
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Phoenix, Ariz. 1830 E. Madison
Pittsburgh 22, Pa. 1337 Oliver Bldg.
Portland, Ore. 1233 N. W. Twelfth Ave.
Salt Lake City, Utah 314 Kearns Bldg.
St. Petersburg 6, Fla. 1763 Ninth Ave., North
Syracuse, N. Y. 514 City Bank Bldg.
San Francisco 4, Calif.
 407 Hallbrook Bldg., 58 Sutter St.
Seattle 1, Wash. 2603 Western Ave.
Shreveport, La. 630 Spring Ave.
Silver Spring, Md. 1410 Dale Drive
Wheeling, W. Va. 22nd and Market Sts.
Toronto, Ontario, Moloney Electric Co. of
 Canada Ltd., 213-219 Sterling Rd.
Montreal 2, Que., Moloney Electric Co. of
 Canada Ltd., Birks Bldg., Phillips Square



... more important than gold!

The most important metal today is not the tons of gold buried at Ft. Knox!

Far more important are the millions of tons of iron and steel scrap so desperately needed to make new steel. All scrap, actual and potential, needs to be gathered up and channeled to the steel producing plants-NOW, today, tomorrow and tomorrow. So long as the steel industry is called upon to produce two million and more tons of ingot steel per week, it must have one

million and more tons of scrap each week.

Steel producers are getting the iron ore, limestone and coal they need. But the scrap situation is critical and will continue to be so until inventories are built up substantially.

As a user of steel-as one interested in seeing that America's rearmament program is not too little and too late-you can do your part to see that your community and your business keep scrap moving toward the mills.



The Youngstown Sheet and Tube Company

General Offices--Youngstown 1, Ohio
Export Offices--500 Fifth Avenue, New York

MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

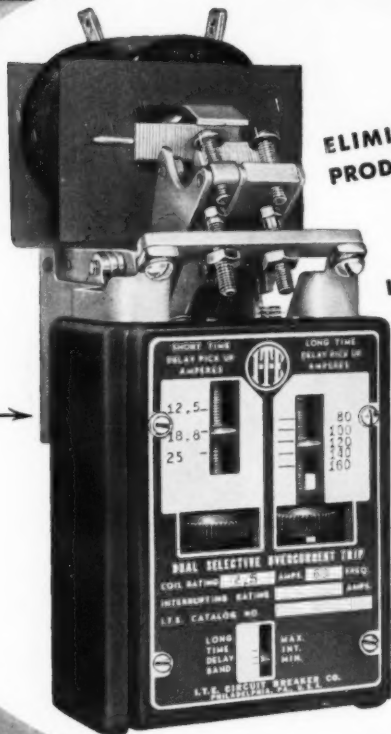
The steel industry is using all its resources to produce more steel, but it needs your help and needs it now. Turn in your scrap, through your regular sources, at the earliest possible moment.

SERVICE CONTINUITY

ELIMINATES COSTLY
PRODUCTION BREAKDOWNS

ISOLATES SYSTEM FAULTS

SAVES UP TO 63% ON
INITIAL INVESTMENT



Direct-Acting Selective Overcurrent Trip Devices are available for I-T-E KA, KB, KC, and LG type circuit breakers in the following ratings:

15,000 to 100,000
amperes interrupting
capacity

100 to 6000 amperes
continuous

MODERN I-T-E DIRECT-ACTING SELECTIVE TRIP BREAKER PROTECTION

It's easy to protect production and profits against disastrous total power failure in complex electrical distribution systems. The cost is lower than you think.

Modern Selective Tripping—pioneered and developed by I-T-E—eliminates the failings of inadequate systems which can tie up an entire plant or utility with a single short somewhere along the line.

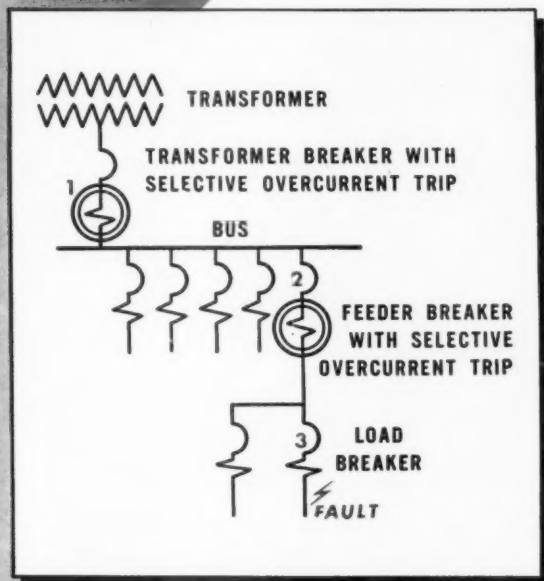
Selective Tripping limits the fault to one affected area only. Production continues—uninterrupted—throughout the rest of the system.

I-T-E TRIP DEVICE SAVES 63% ON INVESTMENT
Secret of this efficient delayed-action circuit breaker protection is the I-T-E

Direct-Acting Selective Overcurrent Trip Device. Developed by I-T-E engineers to replace complex, expensive transformer-relay auxiliary apparatus, this unique tripping device gives one more reason for I-T-E leadership in the design and application of quality circuit breakers and switchgear.

Positive—compact—dependable, the low-cost I-T-E Trip Device saves you up to 63% on accessory cost per circuit! And because it is a *direct-acting* device—an integral part of the circuit breaker—no additional space is required on your switchboard panel. Assure service continuity. Install I-T-E Selective Tripping in your plant.

COSTS LESS THAN YOU THINK



HOW SELECTIVE TRIPPING WORKS

I-T-E circuit breakers, arranged in series, are preset to open in definite sequence (3, 2, 1 in diagram). If there is a sudden overcurrent or short circuit in any branch of the system, only the breaker (3) closest to the fault will open. Other breakers—other production machinery—in the system are unaffected.

ANOTHER I-T-E "FIRST"

Here is one more I-T-E "first"—another major I-T-E development to help industry protect production and save. Originally developed for the Navy during the War, the I-T-E Direct-Acting Selective Overcurrent Tripping Device has since been refined and perfected for industrial and utility use.

Call on I-T-E engineers—specialists in circuit breakers and switchgear—to see how positive, dependable I-T-E *Direct-Acting Selective Tripping* can protect your plant operation. See how much you can save.

For selection and application data on I-T-E large air circuit breakers, including selective tripping arrangements write for Catalog Section 1003 today. I-T-E Circuit Breaker Co., 19th and Hamilton Sts., Phila. 30, Pa.



LOW-VOLTAGE SWITCHGEAR

I-T-E CIRCUIT BREAKER CO. • 19TH AND HAMILTON STS. • PHILADELPHIA 30, PA.

CANADIAN MFG. AND SALES: EASTERN POWER DEVICES, LTD., TORONTO • EXPORT SALES: PHILIPS EXPORT CORP., N. Y. 17, N. Y.

B-M *Fittings*

**ARE APPROVED AS
CONCRETE-TIGHT**



When setting E. M. T. in concrete you can make each job easier and more profitable by using Briegel All Steel Indenter Fittings that have UL approval as CONCRETE-TIGHT. Contractors the world over recognize their cost cutting qualities and the fact that they make each wiring job a better job. It is only natural that Briegel Fittings are the most widely used E. M. T. connectors and couplings.



Cross Section
Showing
Indentations.



BRIEGEL **METHOD
TOOL
CO.**
GALVA, • ILLINOIS

Distributed by

The M. B. Austin Co., Northbrook, Ill.; Clayton Mark & Co., Evanston, Ill.; Clifton Conduit Co., Jersey City, N. J.; General Electric Co., Bridgeport, Conn.; The Steeltest Co., Youngstown, Ohio; Pittsburg Standard Conduit Co., Pittsburgh, Penn.; Wagner Malleable Products Co., Decatur, Ill.; J. B. Richards Co., Carnegie, Penn.; Konde Mfg. Co., Ltd., Preston, Ont.



NEW
CARTRIDGE-POWERED
MODEL 450

NOW! Do your construction fastening up to 100 times faster with **REMINGTON STUD DRIVER** ... and do it safely!

This revolutionary tool attaches steel or wood structural pieces to concrete or steel surfaces in seconds... cuts costs and working time on construction jobs. Completely self-powered, the Stud Driver sets as high as 5 studs per minute... with no outside power source or other equipment required. Studs have pull-out resistance as high as two tons!

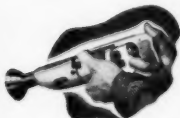
Test-proved to be the world's

finest and speediest fastening system, the Model 450 Remington Stud Driver is made by Remington Arms Company, Inc., America's oldest and foremost sporting arms manufacturer. Price for Model 450, complete in rugged steel carrying case—only \$119.50. To obtain detailed information on this time and money-saving tool, and for the name of your nearest distributor, fill out and mail the coupon below.

*It's fast, easy and
safe to operate
the Remington
Stud Driver*



Simply hand-assemble stud and power cartridge, load as a unit in easy-to-open Remington Stud Driver, and close.



Press loaded Stud Driver firmly against surface, depress safety lever and pull trigger. Explosive charge imbeds stud solidly.

Speeds all these jobs . . . and many more!

1. Attaching conduit and panel boxes to steel, concrete or brick.
2. Anchoring fluorescent and other lighting fixtures in concrete.
3. Radio and television fastening.
4. Fastening conduit clips to concrete or steel.
5. Fastening eye bolt in concrete for stringing wires.

"If It's Remington—It's Right!"

Remington



Remington Arms Company, Inc.
Industrial Sales Division, Dept. EC-7
939 Barnum Ave., Bridgeport 2, Connecticut

I am interested in obtaining detailed information on the Model 450 Remington Stud Driver.

Name

Firm

Position

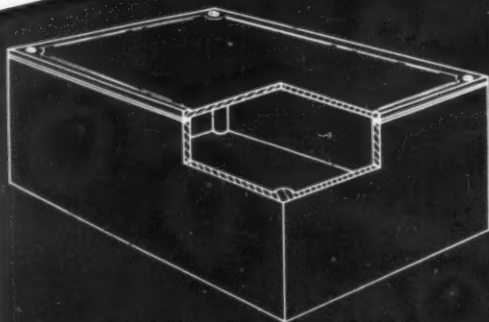
Address

City State

164 STANDARD

**UNFLANGED JUNCTION
AND PULL BOXES—H1200 TYPE
SURFACE MOUNTED**

**PLUS low-cost custom
to meet thousands of**

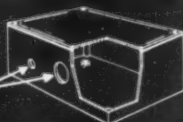


STANDARD CONSTRUCTION

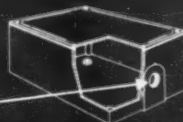
Cast iron—hot dip galvanized • Rubber Gaskets •
Lengths from 4" to 48" • Widths from 2" to 36" •
Depths from 2" to 17" • Larger boxes have adequate
additional screws in order to insure weather-tightness

TYPICAL

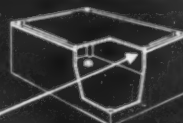
Entrances drilled
or drilled and
tapped to
specification



Bosses for extra
thickness to provide
five threads—
drilled and tapped
if desired



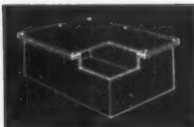
Special gaskets
of Neoprene,
pure gum,
Vellumoid or
graphite-free
compressed asbestos



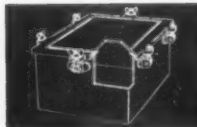
Some of the other Major Types
of Cast

BOXES BY HOPE

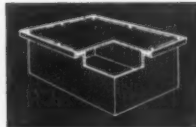
available with or
without custom variations



H1800—Flat flanged boxes for surface mounting. 67 sizes from 4x4x3 to 36x36x12. Also for Class II (Groups E, F, and G) hazardous locations



H1200—Hinged boxes for surface mounting. 128 sizes from 5x5x3 to 36x36x12. Also available with terminal blocks factory-mounted in place



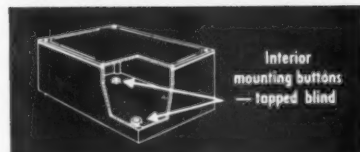
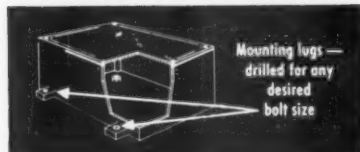
H7000—Flanged recessed cover boxes, for flush mounting in concrete or for surface mounting. 51 sizes available from 4x4x3 to 30x24x12

HOPE ELECTRICAL PRODUCTS CO., INC.

SIZES

**modifications
special needs**

MODIFICATIONS



H5900 — Checkered cover sidewalk boxes for flush mounting. 53 sizes from 6x6x4 to 36x24x14. Checkered cover cross-ribbed for extra strength

**338 WILSON AVENUE,
NEWARK 5, N. J.
Mitchell 2-4426**

CHECK THESE REASONS FOR BUYING CAST BOXES* BY HOPE



1. Hundreds of sizes carried in stock for prompt shipment.



2. Custom modifications factory-made promptly and at moderate cost.



3. All boxes of strong, dense, durable cast iron. Excellent machining qualities permit easy hole cutting and sharp threading in shop or in the field.



4. All boxes hot dip galvanized for lasting protection without need of recoating.



5. Weatherproof construction—tightly gasketed closure between box and cover will not permit entry of rain, snow, sleet or dust under normal conditions.



6. Convenient to order — your local distributor will handle your requests for standard or special BOXES BY HOPE.

**GET
THE FULL STORY**

on the Hope Line—

WRITE

on Company Letterhead
for Catalog

***OUTLET BOXES and FITTINGS •
JUNCTION and PULL BOXES •
HINGED CABINETS • TERMINAL
BOXES • EXPLOSION HOUSINGS**

EXPLOSION HOUSINGS

In addition to its line of boxes for general-service conditions, Hope manufactures a complete line of explosion housings which have been extensively used in Class 1, Groups C and D hazardous locations. Typical applications include chemical, petroleum and powder plants, pump rooms and grain elevators.

Bryant Announces New Safety for 250 Volt Grounding Applications

A new design of 3-wire grounding devices is now available for 250 volt applications. The proper use of these devices makes it impossible to plug 125 volt appliances into 250 volt outlets and vice versa because:



The 250 volt devices have power blades and slots in tandem.



125 volt devices have power blades and slots in parallel.

These new devices were developed to conform with grounding requirements of Article 2545 of the National Electrical Code. They bring new safety and utility to many applications—portable tools and equipment in industrial plants, commercial establishments, public buildings and building construction, under such installation conditions as:

1. Hazardous locations.
2. If operated at more than 150 volts to ground.
3. In other than residential occupancies, exposed metal parts of portable appliances used in damp or wet locations, or by persons standing on the ground or on metal floors, or working inside of metal tanks or boilers, shall be grounded, except where supplied through an insulating transformer with underground secondary of not over 50 volts.

TO PERMIT THESE DEVICES TO FUNCTION SATISFACTORILY, EFFECTIVE GROUNDING MUST BE PROVIDED.

For complete listing and description of this new line of Bryant quality wiring devices, send for page 34E, The Bryant Electric Company, Department A, Bridgeport 2, Connecticut.

Listed as Standard by Underwriters' Laboratories, Inc.

THE BRYANT ELECTRIC COMPANY
BRIDGEPORT 2, CONNECTICUT

Chicago — Los Angeles

J 99874

**New
Line**

FLUSH MOUNTING OUTLETS



No. 5661
Single



No. 5662
Duplex

CONNECTOR BODIES



No. 5669
No. 5670
Armored with
Cord Grip



No. 5678
Flush
Connector Base

3-WIRE CAPS



No. 5663



No. 5664
No. 5665
Armored with
Cord Grip



No. 5674
Black
Rubber



No. 5676
Black Rubber
with Cord Grip

**SPECIFY
BRYANT**

BRYANT
SUPERIOR
WIRING DEVICES

Your answer to tough ventilating problems...



New ILG "PRV" power roof ventilators...

Acceptance of this new product has far exceeded our most optimistic expectations. Architects, engineers, and contractors have been quick to recognize its value. Today, many hundreds of these self-contained ventilating units can be seen on roofs of new hospitals, schools, armed service bases, and industrial buildings throughout the nation. If you haven't heard the complete story on these "PRV" units, call in your nearby ILG representative today. Have him show you why you get positive, controlled ventilation, regardless of wind or weather conditions, through vertical flues or duct systems. Have him explain the numerous extra features you get in this high quality product that doesn't require one inch of valuable indoor wall or floor space. With Branch Offices in over fifty principal cities, your experienced ILG engineer is as close as your telephone. Phone him today (consult classified directory), or send coupon.

VENTILATION

Free! New engineering data bulletin No. 1901 gives you the complete story—features, sizes, capacities, dimensions. Send coupon now!

☐ Send free bulletin No. 1901

Firm Name _____

Individual _____

Title _____

Address _____

City _____

State _____



**BOTH CARRY 390 AMPS.
BUT ROCKBESTOS
A.V.C.[®]
IS 43% SMALLER**

**With higher-rated A.V.C. and a 390 ampere load
INSTALLED COSTS ARE LOWER*—**

- you use a 400 MCM cable *not* 700 MCM
- you use 3" conduit *not* 3½"
- you use *smaller* fittings and lugs
- you have *lower labor costs* because smaller, lighter cable and conduit are quicker and easier to handle.

Size for size
A. V. C.
has a
**HIGHER
AMPERE
RATING**



... YOUR
BEST BUY

**Permanently-insulated Rockbestos A.V.C. can
save you money. Write for the booklet "Cut
Current Carrying Costs."**

*Comparison with Type RH based on Chapter X—National
Electrical Code, 40°C-104°F Ambient

ROCKBESTOS A.V.C.

ROCKBESTOS PRODUCTS CORPORATION
New Haven 4, Connecticut

NEW YORK • CLEVELAND • DETROIT • CHICAGO • PITTSBURGH
ST. LOUIS • LOS ANGELES • OAKLAND, CAL.



Equity Savings & Loan Company, Cleveland, Ohio. The main office and three private offices are lighted by Wakefield Ceilings, incorporating PLEXIGLAS diffusers. Architects: Dalton-Dalton Associates, Cleveland. Installed by Parker Electric Company, Cleveland. Wakefield Ceilings are produced by The F. W. Wakefield Brass Company, Vermilion, Ohio.

Lighting . . . Air Diffusion . . . Sound Control . . . Combined in a Luminous Ceiling

The Wakefield Ceiling shown above, with its corrugated PLEXIGLAS diffusing panels, combines three functions in a single installation.

- Mounted wall to wall beneath fluorescent tubes, the acrylic plastic panels provide high level, low brightness, evenly diffused illumination.
- Conditioned air from the space above the luminous ceiling is delivered into the room through the openings at the edges of the corrugated diffusers. The multiple openings insure an even distribution of air, with elimination of drafts on customers and employees.

- The simple framework for the PLEXIGLAS also supports acoustical baffles which absorb sounds from the work area.

This Wakefield method of combining air diffusion and sound control with the best in lighting—using PLEXIGLAS acrylic plastic—can reduce building construction and operation costs. In addition there is the advantage of duct-free, fixture-free appearance.

We will be glad to send you details about the installation shown above, and tell you how PLEXIGLAS may solve your lighting problem.

CHEMICALS



FOR INDUSTRY

**ROHM & HAAS
COMPANY**

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Representations in principal foreign countries

Canadian Distributor: Crystal Glass & Plastics, Ltd., 130 Queen's Quay at Jarvis Street, Toronto, Ontario, Canada.

PLEXIGLAS is a trademark, Reg. U. S. Pat. Off. and other principal countries in the Western Hemisphere.

A L E C

ALUMINUM 'TIP-TOP'[®] WEATHERPROOF

▼ Twenty years ago, ALECTRAL pioneered the use of aluminum as a conductor for all purposes. This General Cable brand was assigned to wires and cables of high tensile strength aluminum, engineered as solid or stranded conductors for transmission and distribution service.

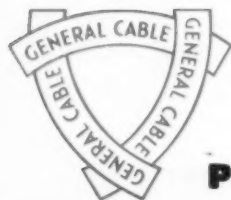
ALECTRAL "TIP-TOP" Weatherproof, a highly weather resistant wire — neoprene jacketed — provides these enduring advantages:

- ① Strips easily and cleanly, minimizing the possibility of nicking
- ② Clean conductor wires permit full benefit of inhibitors and assure positive connections
- ③ Provides high resistance to abuse, either mechanical or from sun's rays, rain, heat and cold
- ④ Permits easy installation and re-use where desired.

GENERAL CABLE CORPORATION

EXECUTIVE OFFICES: 420 LEXINGTON AVE., NEW YORK 17, N. Y. • SALES OFFICES IN PRINCIPAL CITIES OF THE UNITED STATES

"More Power to You"



PIONEERS IN ALUM

TRAL

General Cable
aluminum experience
and know-how
pays off on
Distribution Lines



I N U M W I R E A N D C A B L E

SORGEL AIR-COOLED DRY-TYPE TRANSFORMERS

Sub-Stations and Power Centers

for indoor installations

Engineered to meet your exact requirements

Not necessary to design or change your installation to fit a "standard"

**Any type of primary switch gear.
Metering—primary or secondary, to suit.
Secondary breakers, main, branch, or tie.**

Interlocked or automatic throw-over. Draw-out or stationary types.
Magnetic trip, or thermal, or combination.

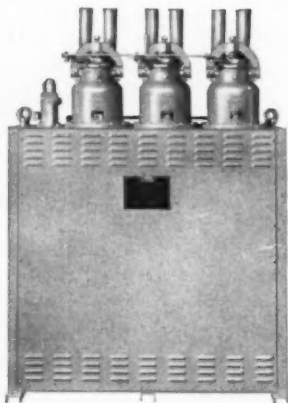
All incorporated with high quality, liberally designed
SORGEL Air-Cooled Transformers

All factory assembled, wired and tested.

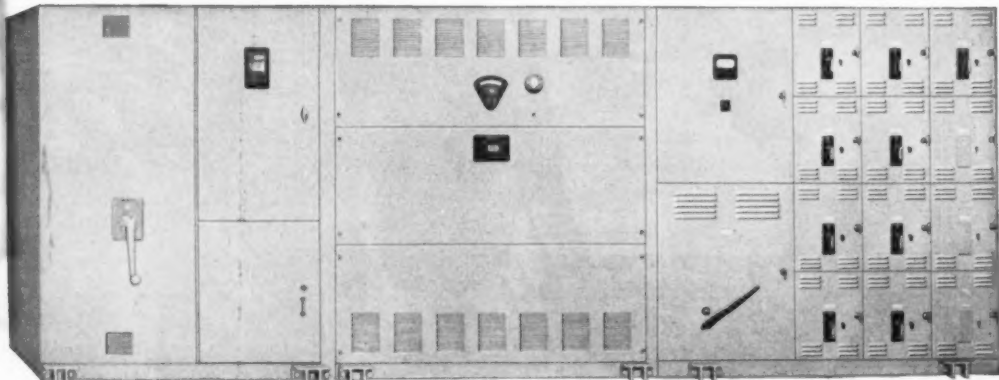
Mounted on a substantial steel base

Shipped as a single unit or in sections, accurately co-ordinated for
easy assembly on the job.

Sizes up to 2000 Kv-a. All voltages up to 15 KV.



500 Kv-a., 3-phase, 4160 volt Transformer,
equipped with primary oil fuse cutouts



2000 Kv-a., 3-phase, 13,200 volt unit Sub-Station

With forced draft fans, automatically controlled by temperature indicator to increase transformer capacity 25%; primary fused load break switch and kilowatt-hour meter, secondary voltmeter and drawout circuit breakers.

Also a Complete Line of Conventional Air-Cooled Dry-Type Transformers

1/4 to 2000 Kv-a. Single phase and poly-phase. 120—240—480—600 volts.

Sales Engineers in Principal Cities

SORGEL ELECTRIC CO., 836 West National Ave., Milwaukee 4, Wis.

Pioneers in the development and manufacturing of Air-Cooled transformers

The 60-second gold mine!

60 SECONDS MAKE A MINUTE . . . minutes run into hours and into *money* before you know it! And that's why Gedney Fittings are the best buy obtainable today. Gedney Fittings are machined with absolute accuracy. They'll save you the minutes that can add up to hundreds of dollars of a workman's time—each year!



GEDNEY FITTINGS FIT!

- ★ Accurate castings of malleable iron . . . no breakage.
- ★ Threads cut true . . . perfect conduit alignment.
- ★ Designed to fit . . . vibration cannot work it loose.



GEDNEY
ELECTRIC COMPANY



RKO BLDG. • RADIO CITY • NEW YORK 28
Foundry, Factory and Shipping Point: Terryville, Conn.

UP and DOWN LIGHTING
for better seeing conditions



Wheeler DIFFUSER TYPE FLUORESCENT FIXTURES

Get the benefits of greater seeing comfort — reduced brightness contrasts — with the new DIFFUSER TYPE Fluorescent Fixtures — pioneered by Wheeler! Apertures located in the top of the all-white porcelain enameled steel reflector direct approximately 5% of the light upwards . . . lessen contrasts . . . provide more comfortable seeing and working conditions. Fixtures are available for use with all Slimline and General Line Fluorescent Lamps. Write Wheeler Reflector Company, 275 Congress Street, Boston 10, Massachusetts.



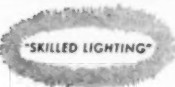
Wheeler

REFLECTORS



Distributed Exclusively
Through Electrical
Wholesalers

MADE BY SPECIALISTS IN



EQUIPMENT SINCE 1881



NEITHER SURF, NOR ROCKS, NOR BARNACLES....

This "beat-up" looking piece of TIREX Cord is a veteran of many battles with the sea. Here's an excerpt from a field report describing its performance.

"TIREX Cords and Cables have been found to be the only product that can be counted upon to withstand consistently the severe abuse to which they subject cables in their research work. One instance was given: A TIREX Cord led from a heavy instrument located on the ocean bottom several hundred yards from the shore, through the surf and over a rocky water line to the point where they were taking readings. After an unexpected storm they found this heavy instrument cast far up on the beach with the cord still attached, but in a tangled mass. The instrument was a total loss but the cord was intact and was used again on many subsequent occasions without requiring repair."

Isn't that the kind of service you want from your portable cords and cables? Of course it is! You can be sure to get it if you specify and be sure you get Simplex-TIREX Cords and Cables. They're a product of Simplex Research.

Simplex Research gave you the first heavy duty, rubber-jacketed portable cord or cable; the first low water absorption insulation; the first rubber-jacketed underground cable. Besides these notable "Firsts" Simplex Research has provided a great many developments which have enriched the art of cable design.

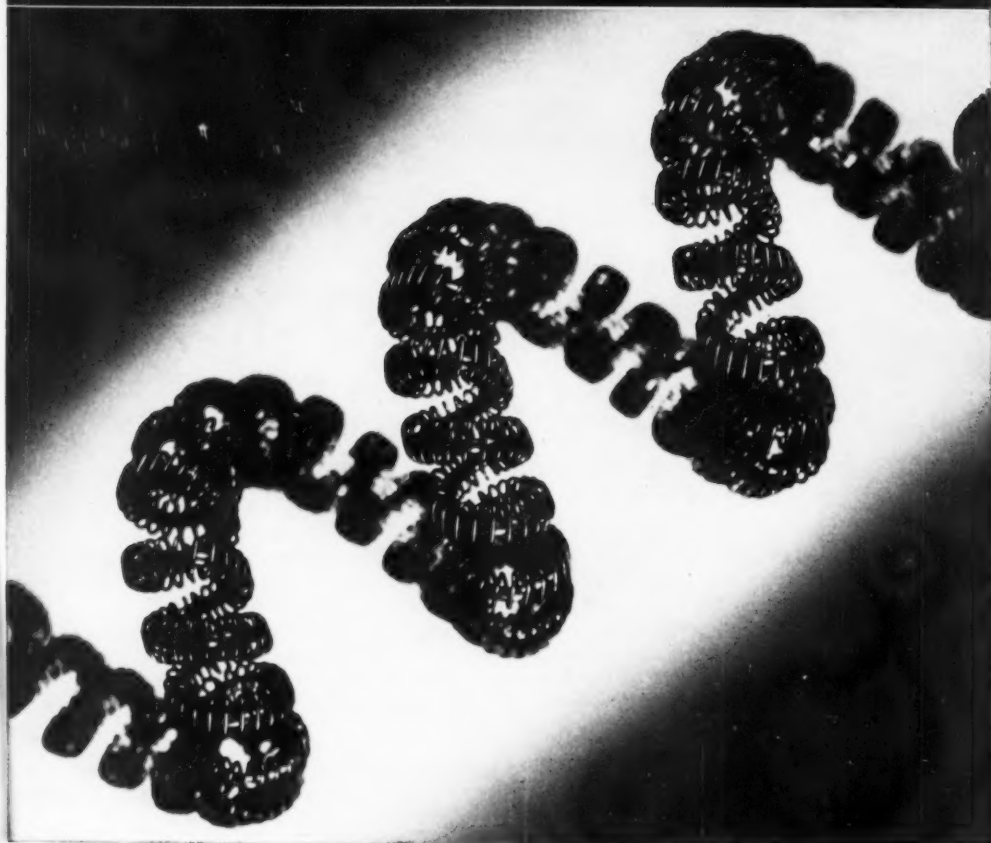
TIREX is not made nor recommended to be used under water. However, the spectacular life of this TIREX Cord illustrates perfectly the inherent ruggedness of TIREX. This ruggedness has been deliberately built into all TIREX Cords and Cables. It is one of the "plus values" that you get when you use TIREX.

SIMPLEX-TIREX IS A PRODUCT OF SIMPLEX RESEARCH

SIMPLEX-TIREX

SIMPLEX WIRE & CABLE CO., 79 SIDNEY ST., CAMBRIDGE 39, MASS.

You expect the best value from G-E fluorescent lamps



**How an extra coil gives
your customers extra light
from G-E slimline lamps**

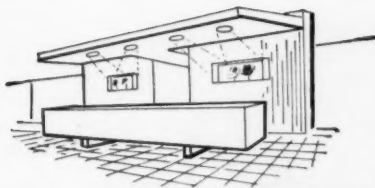


A special chemical deposited on tungsten wire at each end of a fluorescent lamp helps start the stream of electrons that bring light. When the chemical finally burns out or drops off, out goes the lamp. So in most fluorescent lamps, slimline and standard alike, wire twisted into a double coil is used to hold as much of the chemical as possible as long as possible.

But General Electric lamp scientists found a way to coil the coil again—making a *triple* coil. This triple coil holds more of the starting chemical and holds it more securely. Used in G-E slimline and other General Electric instant-start fluorescent lamps, it gives your customers extra light for their money because it makes the lamps last longer. This is another example of why you and your customers can *expect* the best value from G-E fluorescent lamps.

You can put your confidence in—

GENERAL  ELECTRIC



Pyrex® brand Lenslites

give you **unusual design flexibility**

For a variety of distinctive lighting effects at low cost—plan on using PYREX brand LENS LITES. They offer a highly flexible medium for control of incandescent light sources. Wide variations in light distribution can be obtained simply by changing the position of the lamp and reflector relative to the LENS LITE, or by using various distribution patterns in the glass itself.

Heat-resistant PYREX brand LENS LITES can be used with lamps up to 1000 watts without danger of heat breakage. Carefully engineered prisms assure precise light control and minimize brightness. Stippled rear surface produces smooth, even illumination.

Available both round and square in a number of sizes and in concentrating, wide, and extra-wide angle distribution patterns, PYREX brand LENS LITES may be obtained from leading fixture manufacturers. For complete design data and specifications send for Bulletin LS-9. Simply mail the coupon.

TEMPERED PYREX LENS LITES for institutional applications . . . Tempered by a special heat treating process, PYREX LENS LITES are immediately available in sizes 8" and 12" for use in hospital psychiatric wards, prisons and similar institutions where law requires. Should glass be broken, it shatters into tiny particles. Larger sizes can be tempered to order.

APPLICATION SUGGESTIONS—Used in recessed ceiling fixtures with the lamp at focal length, with concentrating pattern, LENS LITES provide high intensity concentrated beams for accent lighting in stores, restaurants, etc.

When the lamp is moved closer to the lens, or with wide or extra-wide angle patterns, the beam spreads proportionately. This creates soft lighting effects for restaurants, banks and cocktail lounges.

By offsetting the lamp, light beam offsets up to 20° are possible. This is particularly desirable for display lighting and for special effects.



CORNING GLASS WORKS
CORNING, NEW YORK

Corning means research in Glass

VISIT THE NEW CORNING GLASS CENTER



CORNING GLASS WORKS, Dept. EC-7, Corning, N. Y.

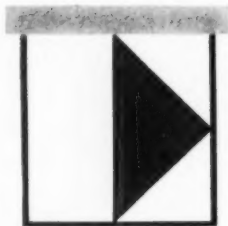
Please send me Bulletin LS-9, describing PYREX® brand Lenslites.

Name _____ Title _____

Firm _____

Address _____

City _____ Zone _____ State _____



*as fundamental as
counter tops...*



*No electrical
contract is complete
unless it contains
raceways for
telephone wires.*

Without working surfaces a kitchen fails in one of its chief functions. And without built-in telephone raceways, walls, too, are functionally incomplete. Raceways conceal telephone wires, a fact which impresses clients and protects walls and woodwork. They mean extra profits for you since costs usually involve only a few lengths of conduit and a few hours labor. You'll find it's good business to consider good looks.

BELL TELEPHONE SYSTEM



There's a *Century* MOTOR To Supply Dependable Power For All Popular Applications

Century motors are available in sizes from $\frac{1}{4}$ to 400 horsepower, in a wide range of types and kinds—single phase and polyphase alternating current, and direct current. All of them are ruggedly built to assure top performance throughout a long service life.

POLYPHASE



Type SC—OPEN PROTECTED
—General purpose motor—meets the needs for most installations where operating conditions are relatively clean and dry. The top half of the motor frame is closed to keep out falling solids or dripping liquid.



Type SC—SPLASH PROOF
—gives the necessary protection where plants must be washed down—keeps water out of the motor even when a hose is applied directly on the frame. Also provides protection against rain, snow, sleet and ice for outdoor installations.



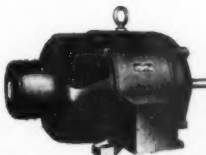
Type SC—TOTALLY ENCLOSED FAN COOLED—protects against dusts, mist or fog detrimental to the vital parts of the motor. The inner frame protecting the motor is sealed to keep out harmful matter.



Type SC—EXPLOSION PROOF
protects against atmospheres charged with explosive dusts or gases. They carry Underwriters' label for specific kinds of hazards.



Type SR—SLIP RING—wound rotor motors are suitable for applications requiring low starting current with high starting torque, reversing, or adjustable speed.



Type SY—SYNCHRONOUS MOTORS—suitable for continuous operation at a uniform load for power factor correction.

CE-645-R

SINGLE PHASE



Type RS—REPULSION START INDUCTION—single phase brush lifting motor suitable for applications requiring high starting torque with low starting current.



Type CSH—CAPACITOR START INDUCTION—single phase motor suitable when high starting torque with normal starting current is required.



Type SP—SPLIT PHASE, INDUCTION—single phase motors—suitable for light starting duty.

DIRECT CURRENT



Type DN—DIRECT CURRENT MOTORS—suitable for use where direct current is available or its use desirable.

These illustrations are typical of Century's complete line of motors. Others available include gear motors, generators, AC and DC motor generator sets.

Specify the right Century motor for all your electric power requirements.

Popular types of standard ratings are generally available from factory and branch office stocks.

CENTURY ELECTRIC COMPANY

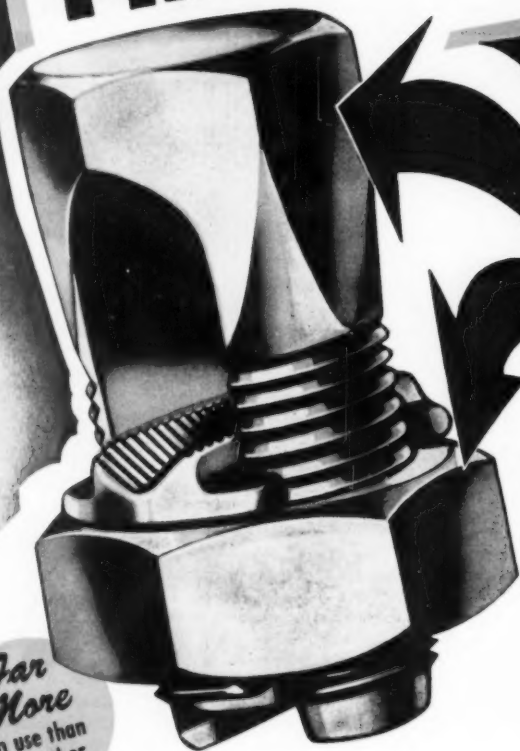
1806 Pine Street
St. Louis 3, Missouri



Circle 10 on Reader Service Card

Approved
by
UNDERWRITERS
LABORATORIES

Here's the **MOST**
PRACTICAL design



**LARGER
SURFACES**

to grip with wrenches from
ANY ANGLE—using either a
socket or open-end wrench.

MORE STRENGTH. In competitive
torque tests, Penn-Union Split-Bolt
Connector withstands 15% to 55%
higher clamping pressures.

MAXIMUM CONTACT provided
by V-groove; conductors protected
by bevelled slot.

PRECISION MADE, with rigid in-
spection. Smooth accurate threads
assure maximum pressure—perma-
nently maintained.

*Far
More
in use than
any other*

For taps, dead-ends, parallel connections, etc., in any location. Can be furnished
in bronze or aluminum. Re-usable over and over.

PENN-UNION ELECTRIC CORPORATION, Erie, Pa.
Canada: Dominion Cutout Company, Ltd., 250 Richmond St. West, Toronto

With or
without
retainer.



PENN-UNION

Look beyond blue

protection

Let's be realistic: While approval tests require short circuit interruption at 5000 amperes, short circuits of that size are virtually impossible in most circuits. Wiring and circuit components . . . just what you are protecting . . . would be damaged far below 5000 amperes.

Common short circuits run 200 to 300 amperes at most. That is why most equipment manufacturers specify HEINEMANN Circuit Breakers. With HEINEMANN, the instantaneous trip point is *always* 10 times the rating . . . high enough to allow harmless, temporary overloads; yet sufficiently low to provide absolute protection.

This performance in the *critical protection zone* is far in excess of mere approval tests . . . and it is a necessity for adequate protection of your equipment and circuits.

don't use heat . . . USE POWER

**CRITICAL
PROTECTION
ZONE**



INSTANTANEOUS TRIP POINT

New Literature tells the facts

Send for your copy of the new, informative bulletin entitled, "What You Should Know about Circuit Breakers". HEINEMANN ELECTRIC COMPANY, 132 Plum Street, Trenton 2, N. J.

INSTANTANEOUS TRIP POINT of Heinemann Circuit Breakers is *always* 10 times rated capacity. It never changes.

TIME DELAY ZONE provided by change in magnetic flux caused by moveable core. Delay time is inversely proportional to overload.

**RATED
CAPACITY**

RATED LOAD is always carried. Heinemann Circuit Breakers are fully magnetic . . . employ no thermal elements, thus never need de-rating. They are unaffected by heat or cold.

HEINEMANN
Circuit breakers



HEINEMANN Circuit Breakers . . . One, two and three pole . . . 10 millamps to 100 amperes

SLASH YOUR Now-Federal Noark TYPE at TYPE "C" prices!



Install the best and save money too! Meet every requirement up to 1200 amps. with the new Federal Noark ACI Industrial Type "A" Switches. Up to and including 200 amps., ACI switches give you all the design advantages of the now famous Front-Operated Safety Switches and provide a *real* Type "A" Switch at Type "C" prices.

The new ACI Industrial Switch line—with voidable interlock—completely eliminates the old Type "C". Selection is further simplified by adding a solid neutral block to each switch through 200 amps. Now each and every switch within this range meets the requirements of

four or more switches under the old system.

The new Front-Operated ACI makes maintenance a cinch. A glance at the man-sized handle, even from across the room, tells instantly whether the switch is "on" or "off." Coolest operation is assured by the patented fuse holder and by only two joints per pole, both under extreme pressure. Maximum safety is provided by guaranteed current break, special arc mufflers or Rolarc snuffers, and accommodations for four padlocks.

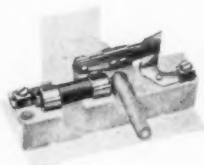
Order money-saving ACI Industrial Switches from your Federal Noark wholesaler for any "A" or "C" specification.

TYPE "D" LINE ALSO SIMPLIFIED

SWITCH COSTS!

"A" ACI Industrial Switches

FEATURES OF FRONT-OPERATED ACI INDUSTRIAL SWITCHES



COOLEST OPERATING ... There are only two joints at each pole, both under tremendous pressure. As proved by field experience this is the coolest, most practical type of switch-blade construction.



COOLEST OPERATING ... Pressure spring of the patented fuse holder is located in block under fuse where unaffected by fuse heat. No screws to vibrate loose or to forget to tighten.



SAFEST ... This is the only visible blade switch with the operating cross bar beneath the switch blades. The operator is safeguarded because contacting blades are always forced open.



SAFEST ... All 100 and 200 amp., 230V. Federal Noark Front-Operated ACI Industrial Switches have arc muffers. Patented Rolarc Snuffers are used on all 575V. switches.



SAFEST ... Man-sized, streamlined handle smoothly and dependably snaps the switch to "on", "off", or "cover open" position. Handle can be locked with as many as three padlocks.



EASIEST TO MAINTAIN ... High Pressure Fuse Clamps allow ready "pull out" removal and "snap in" insertion of fuses. No cross bar or fibre hooks interfere with fuse removal.

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COMPANY**

50 PARIS ST., NEWARK 5, N. J.

FEDERAL NOARK

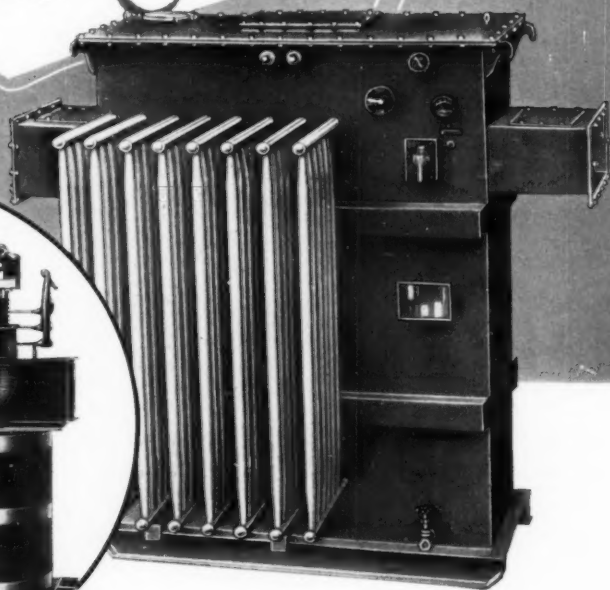
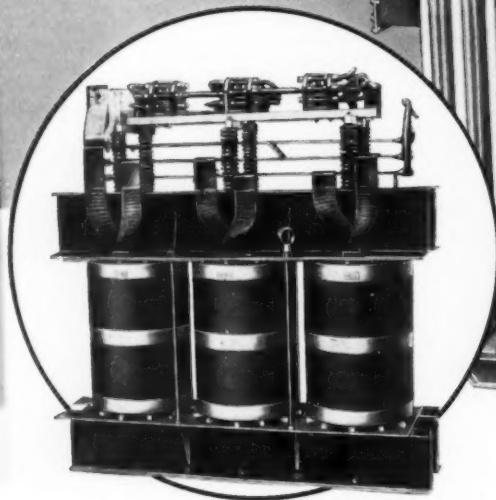


DS • FLEXUNIT PLUG-IN DISTRIBUTION PANELBOARDS • SOLENOID TYPE R
STARTERS • AUTOMATIC TRANSFER PANELS • STANDARDIZED TROUGHS FOR S
VICE AND LIGHTING PANELS • MAGNETIC CONTACTORS • MAGNETIC A
AND LIGHTING PANELS • STANDARDIZED TROUGHS FOR SOCKET TYPE METER • AT WIRING TROUGHS • MULTIBREAKERS
STARTERS • COMBINATION MOTOR STARTERS • REVERSING CONTACTORS AND STARTERS • ACI INDUSTRIAL SWI
PANELBOARDS • FUSI

1500 KVA INDOOR SUBSTATION TRANSFORMER

COMPACT
DEPENDABLE
for
INDUSTRIAL
SERVICE

Uptegraff

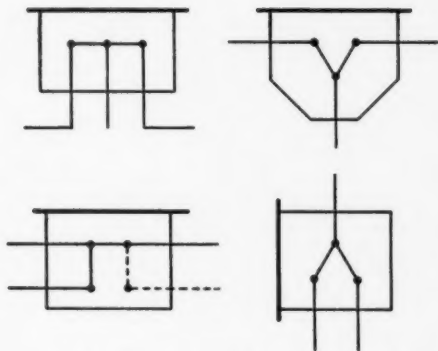
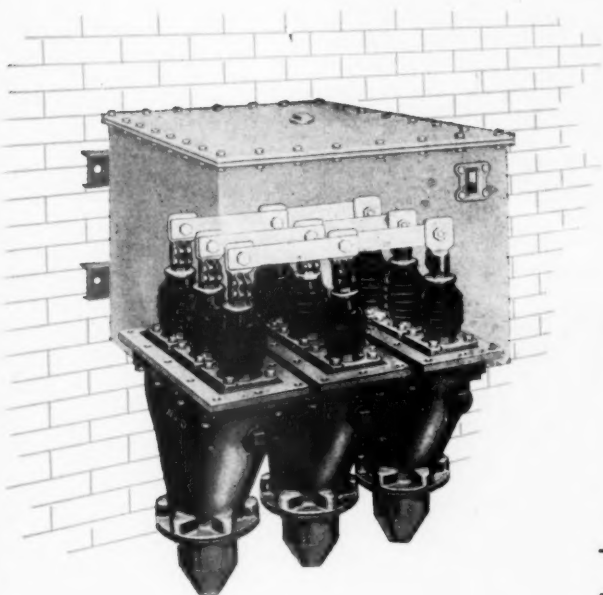


This 1500 KVA Uptegraff indoor Unit Substation Transformer is one of three identical units supplied complete—including switchgear—by Uptegraff for a large mid-western industrial firm. The sturdy design of core and coil assembly is clearly evident in the photograph at the left. The strong, rigid tank is designed to withstand eight pounds pressure or vacuum. Transformer is designed for sealed-tank operation, and a super-sensitive electronic leak-detector is used to insure that even the smallest leaks in tanks and bushings are completely eliminated. Transformer is rated at 1500 KVA, 2400-480 volts, 3 phase.

R. E. UPTGRAFF MANUFACTURING CO.

**SCOTTDALE,
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DON'T CUT THOSE CABLES!
SAVE TIME AND MONEY BY INSTALLING
TYPE "OL" CABLE BOXES TO PROVIDE
DISCONNECTING LINKS FOR SECTIONALIZING.



"OL" CABLE BOXES

Heavy welded steel boxes with "Resistoyl" gasketed covers. Fitted with unit compound filled pot-heads for complete protection of cable ends. Location of pot-heads varied to suit installation conditions.

Boxes are filled with oil (or Askarel)—for minimum size and best electric characteristics.

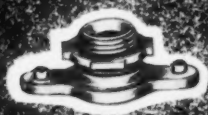
"OL" boxes meet many requirements for non-load break sectionalizing and stop joint connection of cables up to 66 Kv.

Send for new Bulletin BA52 on CABLE BOXES. (Page 10 lists "OL" boxes rated 15 Kv).

*A SKETCH OR OUTLINE OF YOUR INSTALLATION
 CONDITIONS TOGETHER WITH YOUR
 CABLE DATA WILL BRING YOU OUR
 QUOTATION ON SUITABLE "OL" BOXES*

G & W ELECTRIC SPECIALTY CO.
 7780 Dante Avenue, Chicago 19, Ill.

Cable Terminating, Connecting and Sectionalizing Devices
 Representatives in principal cities of U. S. A.
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MODERN FITTINGS

Midwest Electric Mfg. Company

MANUFACTURERS OF ELECTRICAL WIRING PRODUCTS

1625 W. WALNUT STREET
Chicago 12, Illinois

Washington Report

Official Washington's interests this month are in Chicago—and political. But behind the scene back in Washington plans are a-making to snap the public's growing lethargy on defense mobilization back into concern and action. Regardless of party nominations in Chicago, more emphasis will soon be put on completion of expansion goals and military build-up.

Economists are predicting better business during this second half-year period. But mobilizers see a period of extreme tension ahead, lasting probably for several years. Russia is now on the defensive in Europe, a new role for her. She is calculated to meet this situation by: 1) starting a war now, before the West gets stronger; 2) bargaining for a settlement that would stop West German rearmament; or 3) increasing tension in an attempt to frighten or divert the West. The third move seems most likely.

To meet this possibility military officials will drive to hold fast to the present U. S. arms schedule. This program will probably peak early next year at \$50-billion to \$60-billion, maintain this pace for at least 18 months. Politics and DPA decontrol measures have lulled the public into a dangerously apathetic mood, most mobilizers think.

More copper is now available, due to anticipated increased imports. Recent decline in world copper prices resulted in a revised Government price policy—U. S. manufacturers may now pass on to consumers 80% of price differential on foreign purchases between foreign and domestic price. NPA has increased copper allotments by 16,000 tons monthly to make possible foreign purchases up to limit of International Materials Conference entitlements. These actions made possible relaxations effective July 1.

More copper and aluminum can now be self-authorized by all producers of CMP Class B products, under terms of an amendment to CMP Reg. 1, Direction 1. Increases range from 500 to 10,000 lb. of copper, and from 1,000 to 20,000 lb. of aluminum for certain small users regardless of past use, up to 40,000 lb. of copper and 60,000 lb. of aluminum for large users, provided purchases do not exceed 75% of a large user manufacturer's base period use.

Building construction controls were relaxed July 1 by NPA, as a result of the improved supply of copper and aluminum. New rules are in Revised CMP Reg. 6, Amendment 1, and M-100, Amendment 1. Both revisions increase the amounts of copper and aluminum which may be self-authorized.

1952 new construction is now expected to total about \$32-billion, or some 5% to 10% more than January predictions, according to Dept. of Commerce and Labor Dept. estimates. This prediction assumes no major holdup in steel production or copper supply during last half of the year.

Rapid tax write-off for new or expanded defense facilities has been approved for over 11,000 projects involving accelerated amortization in excess of \$20-billion, under terms of the Defense Production Act. While applications are now on the decline, approvals still total nearly \$500-million monthly. But NPA recently announced most applications will be denied hereafter since most expansion goals have now been met or approved.

Open capacity for defense production is available in the plants of 3500 small manufacturers, NPA's Office of Small Business has announced. Names and addresses of these firms, as well as the major product made by each, were listed by NPA, in an effort to have these idle facilities utilized by Federal procurement officials and large prime contractors.

An OPS Service Trades survey recently resulted in over 230 injunctive actions across the country for violations of CPR-34, principally for failure to keep and file records and reports as required.

NO WEAK POWER LINKS

with **DURASHEATH**

ALL-PURPOSE DURASHEATH* can be used for every type of power and lighting application. In combined duct, aerial and direct-burial use, Durasheath effectively resists electrolysis, condensation, weathering, sunlight, organic decay, abrasion, and mechanical injury.

DURASHEATH COSTS LESS to install . . . because it is flexible, easy to handle, light in weight. It may be run in one continuous length *without expensive splicing*. It costs less to maintain . . . because its tough neoprene jacket can take terrific punishment in any use. It costs less to stock . . . because, instead of three cables, one — versatile Durasheath — meets every electrical distribution requirement.

USE DURASHEATH for economy, reliability, and durability. See your nearest Anaconda Sales Office or Distributor. Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.

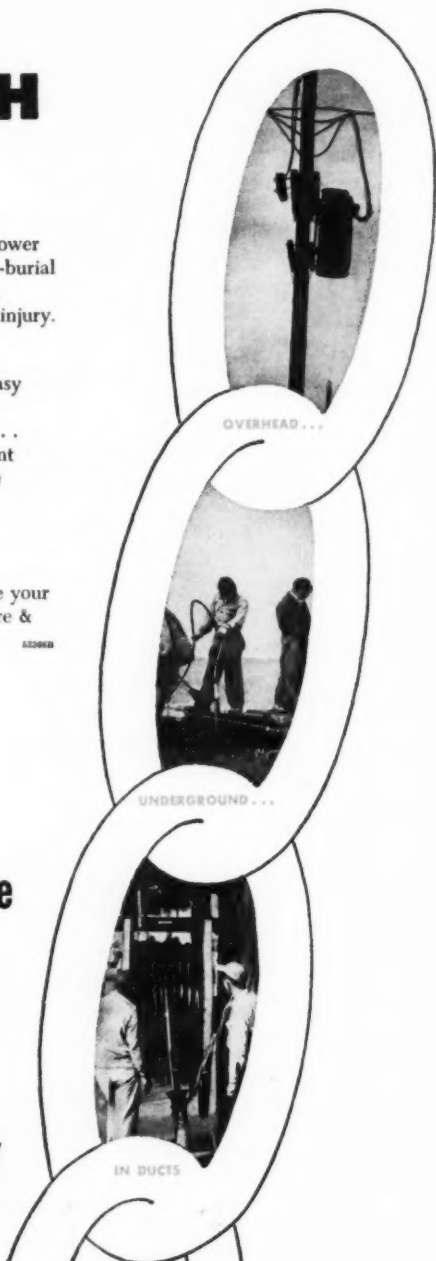
the right cable for the job

ANACONDA® wire and cable

for traffic control, airport power and lighting, mines, industrial plants, railroads, street lighting, and many other uses.

available in all sizes—from large to small—single and multi-conductor.

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when ordered to CAA
Specification L-824.



Specifications

SPECIFICATIONS ARE THE LANGUAGE of electrical construction. The plans and specifications are the accepted descriptions, conditions and rules of the work. The owner, architect, engineer, contractor, distributor and manufacturer carry out individual responsibilities within the framework they provide. They establish the range of choice or selection; the quality of materials and design; the standards of workmanship. A good specification also leaves ample room for engineering and commercial initiative.

THE MASTER ELECTRICAL SPECIFICATION developed in the following pages is a practical tool for specification writing. It provides the framework and, to a considerable extent, the substance of a good specification. It is the fifth and most extensive revision to date of a project initiated 16 years ago. During this time it has had many comments and criticisms which have helped to guide the editors in its revision.

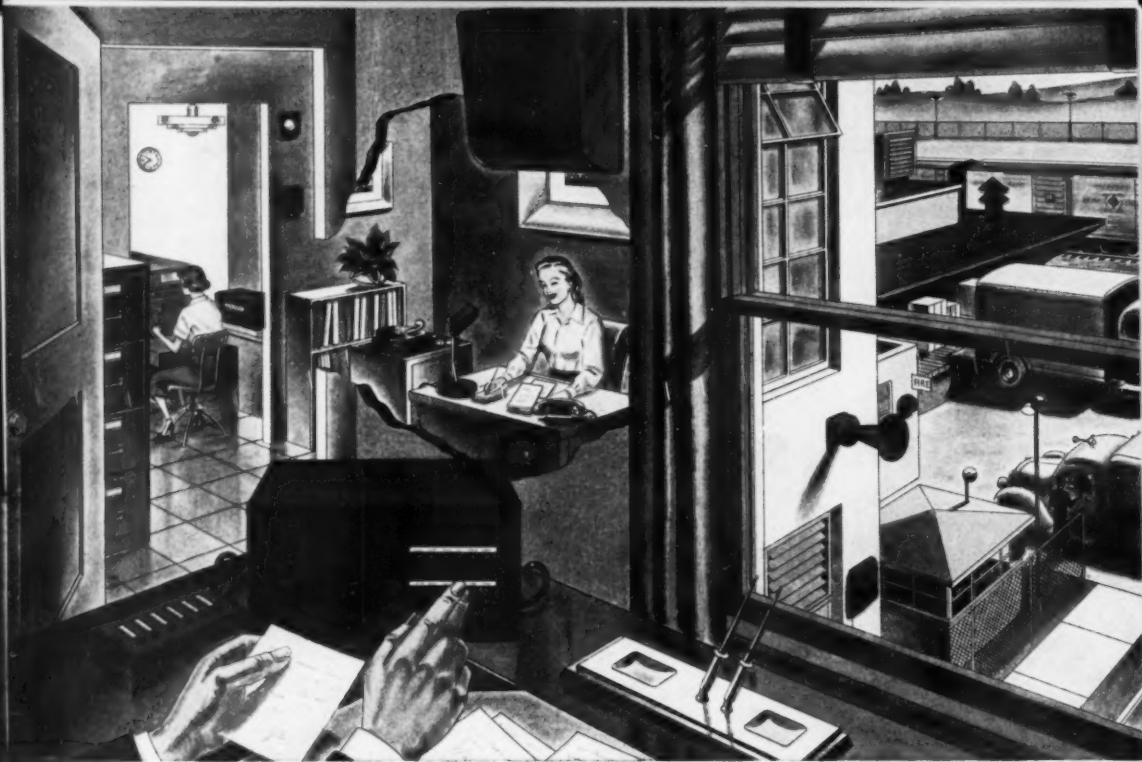
CONTRACTORS, ENGINEERS, ARCHITECTS and others concerned with specification writing, or with detailing more broadly written specifications by others, will find this master electrical specification a useful check on present practice, a source for expanding or modifying working specifications, and a guide for clarifying negotiations and proposals.

HOWEVER WELL CONCEIVED, specifications can only support the engineering concepts they describe and the plans they complement. A master specification cannot take the place of experienced engineering, design and layout. Nor, no matter how well written, can it eliminate the necessity for contracting with firms of known responsibility, skill and experience.

MINIMUM STANDARDS AND MINIMUM QUALITY can be had without specifications. The trend of this master specification, therefore, is to describe or suggest the form for describing methods and materials of superior quality. In its preparation we must be strictly unbiased with respect to the products of particular manufacturers. But for working specifications, preference for particular brands, makes and qualities are the very essence of good specifying.

FROM THE ARCHITECT who, at the professional level, writes a performance specification around a product he knows and respects, to the contractor who must eventually convert his preferences into specific names and catalog numbers on the purchase order, product preference eventually establishes the quality and characteristics of the electrical job. So the work of the manufacturers who display and describe their products, and who seek to establish their special worth or superiority, must be considered an important and most useful part of this specification.

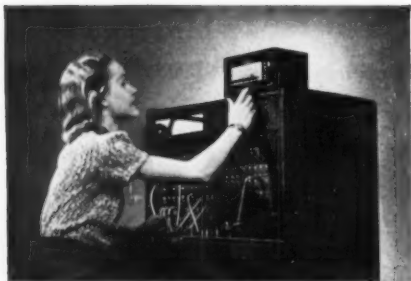
Wm. T. Stuart



WHATEVER THE SIGNALING NEED—you can get the proper equipment from your local Graybar office. Edwards Lokator code-paging or calling systems... Webster intercommunication systems... USI sound-powered telephones... fire

alarm systems... *plus* bells, buzzers, horns, sirens, howlers — *all* are reliable products made by leading manufacturers. Call your near-by Graybar Representative for complete information on any item.

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PROVIDE FLICK-OF-A-SWITCH PAGING. An Edwards Lokator quickly locates personnel at any point throughout the plant. You can make installations using any type of signal equipment — horns, bells, buzzers, musical notes, or flashing lights.

Clear, fast plant-wide intercommunication speeds your customer's day-to-day operations... becomes absolutely vital during emergencies. But, before you buy equipment for your next communication job, check with Graybar to make sure you're getting the right choice of units for long-term service. Get the help of an experienced Graybar Signaling Specialist in planning the system best suited to the job requirements — a system that will save steps, save time, save money... perhaps even lives.

Because Graybar distributes a complete line of signaling equipment, you can get all of your needs from a single convenient source. Your purchasing problem is simplified... you take full advantage of Graybar's nation-wide warehousing system... you can be sure of prompt, on-schedule deliveries.

In addition, Graybar distributes *everything electrical* for wiring, lighting, power, and ventilation—over 100,000 items in all. Graybar Electric Co., Inc. Executive Offices: Graybar Building, New York 17, N. Y.

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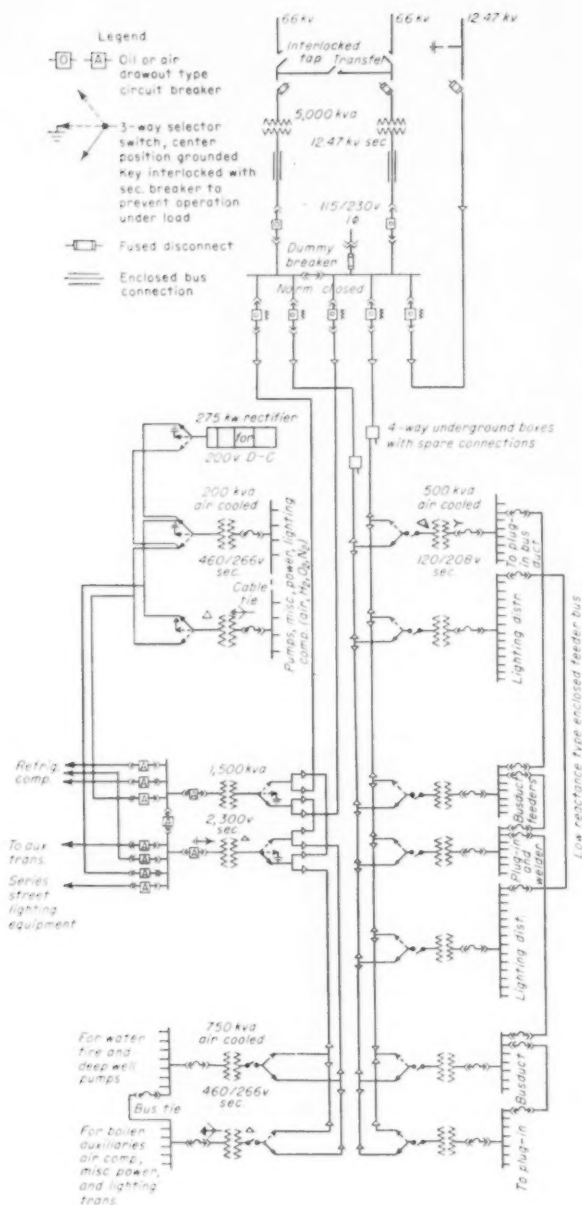
IN OVER
100 PRINCIPAL CITIES

Electrical Specifications

A master specification for electrical construction and installation designed for use as a guide, prototype or reference in the preparation of project specifications, job descriptions, inquiries, recommendations and proposals.

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1.1 General Conditions



This distribution system shows inclusion of several voltage levels, banked secondary busduct installation, automatic protective equipment and transfer facilities for bypassing temporary faults or for segregating sections of the system being altered, expanded or serviced.

The General Conditions of a specification are usually those applicable to all contractors and suppliers. They describe the scope of the work, define the duties and responsibilities of the various parties to the contract, lay down rules, legal requirements and job procedures.

The "General Conditions of the Contract" published by the American Institute of Architects is a widely used standard for this portion of the specification. The following specification paragraphs relate particularly to electrical work and may be inserted in the general conditions or presented in the electrical specification as amending the general conditions.

Scope of Specifications

The work to be done under these specifications shall include the furnishing of all labor and material required to complete and leave ready for operation the installation of the following items, in accordance with these specifications and the accompanying drawings:

(List here each system that is to be included in the electrical contract, such as wiring for lighting; power; special systems-radio, telephones, paging, etc. If only installation labor is required for certain work, so state.)

Much mechanical equipment involves more or less electrical work for installation. The extent of the work required as a part of the electrical contract should be clearly defined.

Standards for Material and Workmanship

All materials shall be new and shall conform with the standards of Underwriters' Laboratories, Inc., in every case where such a standard has been established for the particular type of material in question.

Codes, Permits and Inspections

The installation shall comply with all laws applying to electrical installations in effect, with the regulations of the National Electrical Code where such regulations do not conflict with the laws in effect, and with the regulations of the public utility company.

GRAPHICAL ELECTRICAL SYMBOLS FOR ARCHITECTURAL PLANS

Ceiling Wall.

○	—○	Outlet.
⊖	—⊖	Blanked Outlet.
⊙		Drop Cord.
⊖	—⊖	Electrical Outlet; for use only when circle used alone might be confused with columns, plumbing symbols, etc.
⊖	—⊖	Fan Outlet.
⊖	—⊖	Junction Box.
⊖	—⊖	Lampholder.
⊖ _P	—⊖ _{PS}	Lampholder with Pull Switch.
⊖	—⊖	Pull Switch.
⊖	—⊖	Outlets for Vapor Discharge Lamp.
⊖	—⊖	Exit Light Outlet.
⊖	—⊖	Clock Outlet. (Specify Voltage)

CONVENIENCE OUTLETS

⊖		Duplex Convenience Outlet.
⊖ _{1,3}		Convenience Outlet other than Duplex. 1 = Single, 3 = Triplex, etc.
⊖ _{WP}		Weatherproof Convenience Outlet.
⊖ _R		Range Outlet.
⊖ _S		Switch and Convenience Outlet.
⊖ _R		Radio and Convenience Outlet.
⊖ _▲		Special Purpose Outlet. (Des. in Spec.)
⊖ _●		Floor Outlet.

SWITCH OUTLETS

S	Single Pole Switch.
S ₂	Double Pole Switch.
S ₃	Three Way Switch.
S ₄	Four Way Switch.
S _D	Automatic Door Switch.
S _E	Electroliner Switch.
S _K	Key Operated Switch.
S _P	Switch and Pilot Lamp.
S _{CB}	Circuit Breaker.
S _{WCB}	Weatherproof Circuit Breaker.
S _{MC}	Momentary Contact Switch.
S _{RC}	Remote Control Switch.
S _{WP}	Weatherproof Switch.
S _F	Fused Switch.
S _{WF}	Weatherproof Fused Switch.

SPECIAL OUTLETS

○ a, b, c, etc	Any Standard Symbol as given above with the addition of a lower case subscript letter may be used to designate some special variation of Standard Equipment of particular interest in a specific set of Architectural Plans.
⊖ a, b, c, etc	
S a, b, c, etc	

When used they must be listed in the Key of Symbols on each drawing and if necessary further described in the specifications.

GENERAL OUTLETS

PANELS, CIRCUITS, AND MISCELLANEOUS

⬜	Lighting Panel.
⬜	Power Panel.
—	Branch Circuit; Concealed in Ceiling or Wall.
—	Branch Circuit; Concealed in Floor.
---	Branch Circuit; Exposed.
→	Home Run to Panelboard. Indicate number of Circuits by number of arrows.

Note: Any circuit without further designation indicates a two-wire circuit. For a greater number of wires indicate as follows:
(3 wires) (4 wires), etc.

—	Feeders. Note: Use heavy lines and designate by number corresponding to listing in Feeder Schedule.
---	---

⬜	Underfloor Duct and Junction Box. Triple System. Note: For double or single systems eliminate one or two lines. This symbol is equally adaptable to auxiliary system layouts.
---	--

⊖	Generator.
⊖	Motor.
⊖	Instrument.
⊖	Power Transformer. (Or draw to scale.)
⊖	Controller.
⊖	Isolating Switch.

AUXILIARY SYSTEMS

⬜	Pushbutton.
⬜	Buzzer.
⬜	Bell.
⬜	Annunciator.
⬜	Outside Telephone.
⬜	Interconnecting Telephone.
⬜	Telephone Switchboard.
⬜	Bell Ringing Transformer.
⬜	Electric Door Opener.
⬜	Fire Alarm Bell.
⬜	Fire Alarm Station.
⬜	City Fire Alarm Station.
⬜	Fire Alarm Central Station.
⬜	Automatic Fire Alarm Device.
⬜	Watchman's Station.
⬜	Watchman's Central Station.
⬜	Horn.
⬜	Nurse's Signal Plug.
⬜	Maid's Signal Plug.
⬜	Radio Outlet.
⬜	Signal Central Station.
⬜	Interconnection Box.
⬜	Battery.

Auxiliary System Circuits.

Note: Any line without further designation indicates a 2-Wire System. For a greater number of wires designate with numerals in manner similar to—12 No. 18W-3/4" C., or designate by number corresponding to listing in Schedule.

⬜	a, b, c Special Auxiliary Outlets.
---	------------------------------------

Subscript letters refer to notes on plans or detailed description in specifications.

(In localities where electrical installations are governed by municipal ordinances.) The contractor shall obtain all permits required by the ordinances of the city of _____ and after completion of the work shall furnish to the owner or architect a certificate of final inspection and approval from the electrical inspection department of the city of _____.

(In localities where no ordinance governing electrical work is in effect.) After completion of the work the contractor shall furnish to the owner or architect a certificate of final inspection and approval from the Underwriters' Inspection Bureau having jurisdiction.

Guarantee

The contractor shall leave the entire electrical system in proper working order and shall, without additional charge, replace any work, materials or equipment furnished and installed by him under this contract which develops defects, except from ordinary wear and tear, within one year from the date of the final certificate of approval issued by the inspection department.

When a part of the electrical system is placed in service prior to the date of final approval, that particular system or partial system shall then commence its one-year period of guarantee. This guarantee shall expire one year after such systems or partial systems are placed in service, without regard to the date when the final certificate of approval covering the entire system is granted.

Plans and specifications should provide a clear description of the work. They should be free of ambiguity and should limit the range of alternative materials or methods to definite commercial quality standards.

1.31 Industry Standards

Wherever possible the plans and specification should be sufficiently explicit to describe clearly and exactly the types of material and the quality of workmanship desired. Widely recognized standards of practice or the requirements of local or national codes which apply to the project are usually included in the specification by reference.

The wiring plans, and general plans as well, should show at their

locations all outlets, switches, motors, controllers, auxiliary electrical equipments, panelboards, service equipment, and such special system outlets as signals, telephones, clocks, exit lights, etc. The wiring plans should show the completed wiring details which are in most cases too complex to indicate clearly upon structural plans.

The specifications should contain a complete list of all pertinent drawings, and the following is a typical specification reference to the drawings.

The following drawings accompany this specification and are hereby made a part thereof.

No.	Title
E1	Plot plan and underground feeders
E2	Riser Diagram
E3	First floor plan
E4	Second floor plan
E5	Fixture details
E6	Service entrance details

The drawings and specifications are complementary each to the other and what is called for by one shall be as binding as if called for by both.

For preparation of Wiring Plans see page 230.

TABLE OF BUSDUCT SYMBOLS

	Standard 10-foot section (Plug-in)		Transformer tap opening		Offset
	Standard 10-foot section (Feeder)		Transposition		Circuit breaker adaptor (cubicle)
	Weatherproof duct section		Expansion joint		Section bus bar adaptor
	Flanged end		End cable tap box		Bus bar extension
	End closer		End tap switch box		Vacu-break plug
	Ebony end		Center cable tap box		BP plug
	Panelboard adaptor		Plug-in cable tap box		Circuit breaker plug
	Elbow		Plug-in branch run adaptor		Circuit master plug
	Tee		Fusible plug-in br. run adaptor		Capacitor plug
	Cross		Fusible switch adaptor (cubicle)		Ground detector plug (potentializer)
	Wall Flange		Duct bends up		Temperature indicating plug
	Roof Flange		Duct bends down		Transformer plug

2.1 Service Entrances

Service entrances include the point of connection to utility service apparatus, conductors and raceways connecting to the first point of distribution within the building and the main disconnecting means.

Service entrances consist of two general types:

1. Primary services—electric service purchased, metered and connected at utility distribution voltage and transformed to utilization voltage by the user.

2. Secondary service—electric service purchased, metered and connected at utilization voltage.

Primary services are usually economical only for large properties involving heavy power consumption. Secondary service is customary for ordinary commercial and industrial buildings. Utility engineers should be consulted to determine specific type of service permissible under their regulations.

Service installations follow two general types:

1. Overhead services—open conductors run overhead from the utility pole to the point of connection.

2. Underground services—service conductors carried underground from the utility pole or vault to the point of connection on the customer's premises.

Considerations are usually economic and determined by the type of job, utility rules and safety requirements. Primary services and large secondary services in urban areas are usually underground. Residential and small commercial services are usually overhead.

Specification should indicate the type of service giving the voltage, frequency and phase characteristics; also entrance details (overhead, underground, types of conductors, ducts, etc.)

Service shall be . . . wire . . . phase . . . cycle . . . volts, furnished and connected by the . . . Company to the point of connection indicated on the plans.

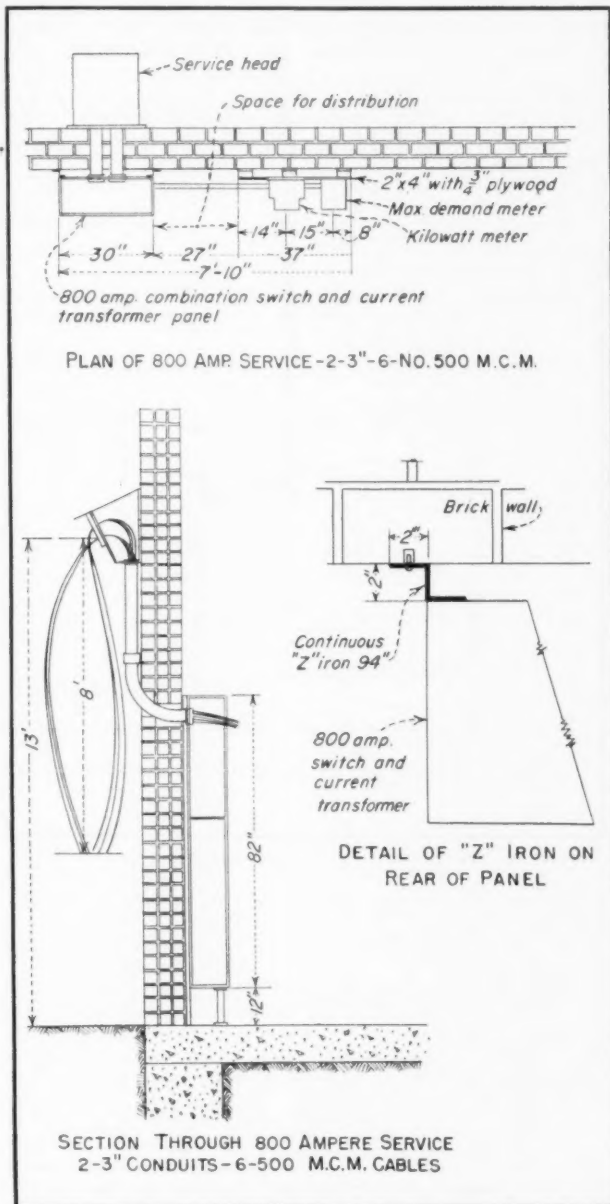
2.12 Primary Services

Primary service requirements vary widely with the practices of individual utility systems. Consult with the utility engineers whenever developing specifications for a particular project.

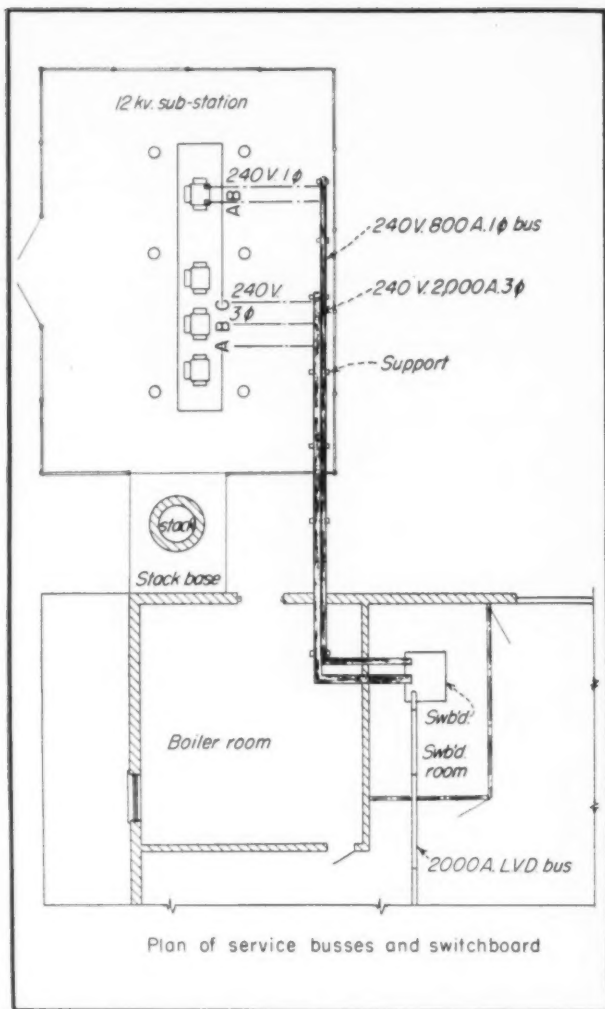
The specification should state by whom the service is to be furnished and installed.

For primary services and feeders to substations and transformers, the following items may be covered by the specifications:

- (1) Number, type, size, and voltage of cables
- (2) Number, type, and size of ducts and conduits



Details of a cable and conduit secondary service entrance.



Bus duct secondary service to an industrial plant from an outdoor 12-kv substation.

- (3) Type of elbows and pipe bends (wide sweep)
- (4) Racking of cables (in vaults and manholes)
- (5) Fireproofing of exposed cables
- (6) Grounding cable sheaths
- (7) Tagging cables
- (8) Testing cables
- (9) Concreting of ducts
 - (a) Amount of concrete around ducts
 - (b) Concrete mix
 - (c) Conduit spacers
 - (d) Method of supporting duct envelope, if suspended indoors

- (10) Rodding ducts
- (11) Excavating and back filling
 - (a) Depth of duct runs
 - (b) Soil conditions
 - (c) Backfilling and tamping

In some cases it may be necessary to specify such special items as:

- (1) Re-enforcing concrete over unstable soil or under tracks and driveways
- (2) Shoring sides of trench
- (3) Pumping water

Primary Service: Furnish and install (number and size) conduits between the utility vault and the customer's vault as shown.

Conduits shall be:

- a. Rigid galvanized conduit.
- b. Impregnated fiber conduit properly seasoned and free of defects. Conduits shall be furnished in manufacturers' standard lengths and shall be of uniform wall thickness. Joints shall be made waterproof with an approved compound.

c. Asbestos cement conduit of the best quality installed and waterproofed at the joints according to the manufacturer's recommended methods.

Conduits shall be installed not less than — inches below the surface and shall grade as shown on the plans.

Conduits shall be enclosed in a concrete envelope not less than — inches in thickness.

Example:

Furnish and install three 4-inch conduits between the utility vault and the customer's vault as shown on the plans. The conduit shall be impregnated fiber of the best quality, properly seasoned and free of defects, furnished in the manufacturer's standard length and shall be of uniform wall thickness. Ducts shall have sleeve joints waterproofed with an approved compound. They shall be installed not less than 24-inches below the surface and graded away from the interior vault. They shall be enclosed in a concrete envelope not less than 3-inches in thickness.

2.13 High Voltage Cable

All high voltage cable shall be impregnated, varnished cambric, or paper insulated, lead covered insulated for voltage and sizes as specified or shown on drawings.

Cable shall be of the very best obtainable quality, manufactured in accordance with the best acceptable practice. All such wire and cable shall be in accordance with, and conform to the latest requirements and specifications of the Insulated Power Cable Engineers Association.

All high tension cables exposed in vaults, manholes, pull boxes or switch rooms or splice chambers and all locations not protected with conduit shall be fireproofed with two wrappings of 3/16-inch thick pure asbestos felted tape backed with coarse jute cloth and covered

with at least a 3/16-inch thick smear coating of asbestos cement. The felted tape shall be immersed in a solution of asbestos cement until it has become thoroughly impregnated and then wound spirally on cable with butted joints and without lap except at bends. The second layer shall be wound spirally in the opposite direction. The asbestos cement shall consist of a chemically neutral powder guaranteed to have no deleterious effect on the lead covering or braid of the cable and to withstand immersion either constant or intermittent without effect on the fireproofing or the mechanical qualities.

Splices—All high voltage splices shall be made with an approved splice for the cable furnished, and shall be of such quality as recom-

mended by the manufacturer of the cable furnished. Splices shall be made by workmen familiar with the art of splicing.

Potheads: High voltage cable shall be terminated with potheads having the rated voltage and conductor capacity to accommodate the cable used. Mounting shall be as required for the conduit system installed. Potheads shall be filled with compound suitable for high voltage service. Care should be observed to avoid heating the compound to a higher temperature than that recommended by the manufacturer.

2.14 Secondary Service

The size, voltage, phase, number of wires (2-wire, 3-wire, 4-wire), frequency and source of supply should be given in the specification and on the

drawings. Metering sequence and connections should be described or diagrammed and any special features explained.

Services may be:

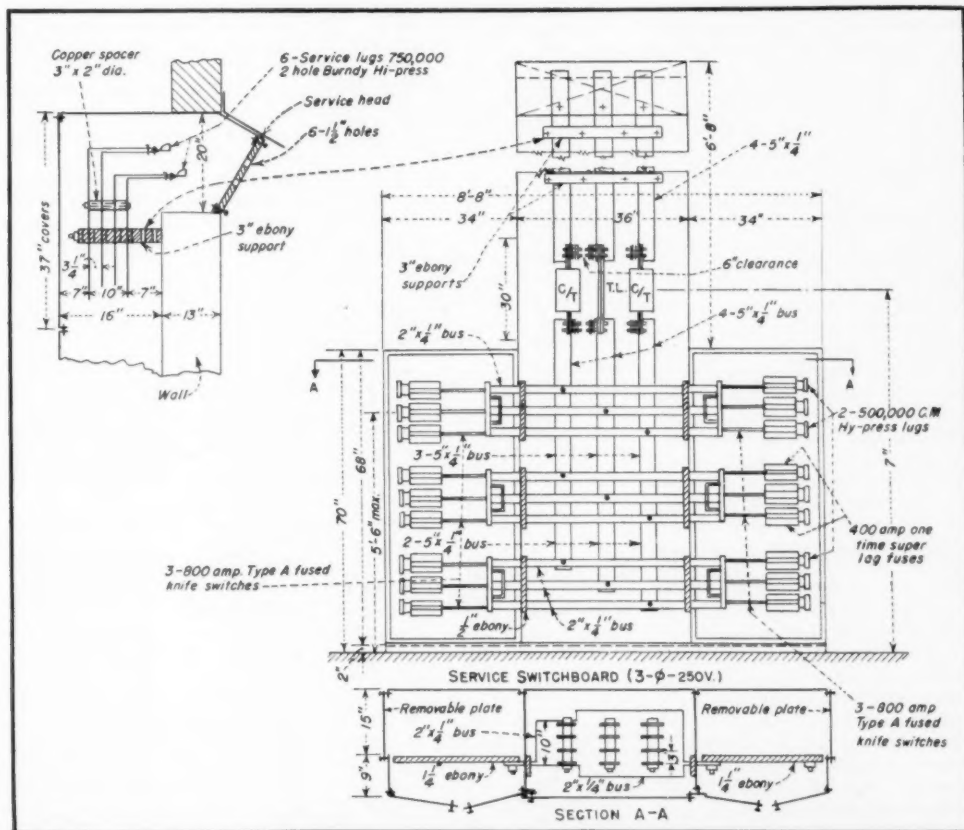
- a—Underground
- b—Overhead

Service entrance conductors shall be run from point of connection by the utility to the service switch at the location shown on the plans.

a. Service shall consist of (number and size) conductors in (size) rigid conduit run underground as shown on the plans.

b. Service shall be (number and size) conductors in conduit.

Conduit shall be run through the wall to a standard service ell fitting and up on the outside — feet to a service head. The insulating cover shall be of a type which separates the conductors. Three feet



Service switchboard has 1,200-ampere buses carried direct to service head. Design has no main disconnect and parallel buses per phase are separated by spacers to reduce heating and skin effect losses.



Service continuity is provided by dual distribution system and provision for emergency lighting or power if main supply fails.

of conductor shall be left extending from the service head for connections to the utility service drop. An approved bracket shall be furnished and installed adjacent to the service head for terminating the service drop. Installation shall be in accordance with the rules of the utility company.

Large secondary services shall consist of: (1) standard bus bars; (2) specially designed bus bar assemblies; (3) multiple conductors per phase enclosed in parallel conduits or trays. In all cases details concerning phase voltage of the system and conditions of soil in case of underground installation should be given in the specifications and shown on the drawings.

For some important security large hospitals, schools, etc., a continuous failure of the electrical system can be economically expensive. Phase and neutral wires must be bonded. All conductors are ungrounded and often insulated or not. Dual distribution is an electrical system design meant to satisfy the purpose. In such systems, two or more independent services and wiring systems are installed. Each handles both the its proportional share of the electric load. Branch circuits are designed so each source serves alternate ones of lighting units in all sub areas. These major areas before run out are only a portion of the total lighting load and also serves a hot emergency.

Increased application of automatic systems in both industries and commercial electrical distribution systems question method of providing continuous of electrical services as one of failure of a portion of the system. Shown as "secondary distribution" this

method with the fall of the lighting panels or a floor to be fed by the installation on that floor, the other fall is served from the unit installation on the floor below or above. The secondary installations fed on the same unit installations are implemented in a ladder and brackets.

What most method is used in some service continuity details of the system should be clearly stated in the specifications and shown on the accompanying drawings.

2.5 Grounding

All metallic conduits, supports, cabinets and equipment shall be grounded in accordance with the latest issue of the National Electrical Code and as shown on the plans.

The carrying capacity of a grounding conductor for direct current systems shall not be less than the capacity of the largest conductor supplied by the system,

except where the grounded circuit conductor is a neutral derived from a balancer; the size of the grounding conductor shall not be less than the neutral, in no case smaller than No. 8.

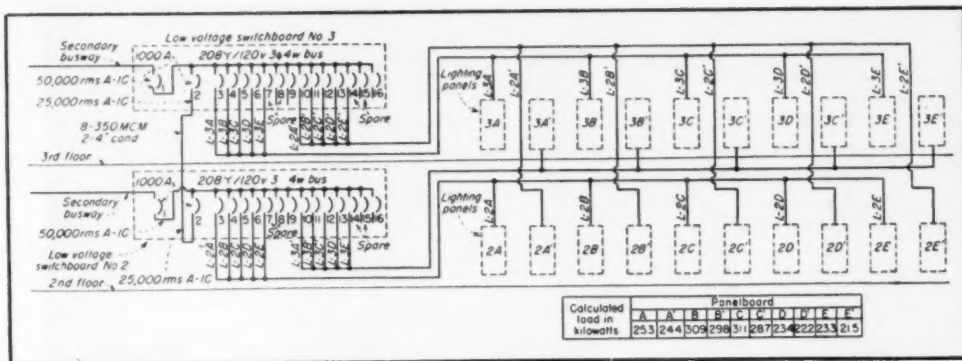
2.5.1 Grounding Conductors

The size of the grounding conductor for an alternating current system, a common grounding conductor, or a grounding conductor for service equipment shall be not less than that given in the accompanying table.

Conduit, pipe or electrical metallic tubing cannot be used alone as the grounding conductor in a wiring system. Wire-cables apply both in bare and insulated conductors and as the minimum permissible. The grounding conductor should be large enough to carry the maximum ground current for a reasonable time without setting off. Grounding conductors of inadequate cross section or high impedance would

Size of Largest Service Conductor or Equivalent for Multiple Conductors	For Phase System and Service Equipment	For Service Equipment Only	For Service Equipment Only	Rating or Rating of Equipment or Capacity of Equipment (Amps)	Size of Grounding Conductor which will carry (Amps)		
					Copper Wire (Amps)	Aluminum Wire (Amps)	Electrical Metallic Tubing (Amps)
	Copper Wire (Amps)	Aluminum Wire (Amps)	Electrical Metallic Tubing (Amps)				
				25	16	12	12
				35	18	14	14
				45	20	16	16
				55	22	18	18
				100	36	28	30
				200	56	44	46
				400	86	68	70
				600	108	86	90
				800	126	100	105
				1000	150	118	125
				1200	168	132	140
				1500	207	165	175
				2000	276	220	235

* Permissible only when part of an approved cable assembly.



Split-secondary system assures service continuity. Half of panels are fed from each of two interconnected unit substations.

burn off and leave equipment at high voltage to ground. This would be a dangerous condition.

Grounding conductors should be so located as to permit as far as practicable, the shortest and most direct path to the ground clamp. Ground connections to plant equipment should be made as close to current carrying parts as practicable and not to separate feet.

All ground connections shall have clean contact surfaces and shall be tinned and sweated while bolting. Unless otherwise specified, ground cables shall be installed in exposed conduit, and connections shall be made readily accessible for inspection. Connections shall not be made underground or concealed in floors or walls.

Interior raceway and equipment: The size of the grounding conductor for conduit, cable sheath or armor, and other metal raceways or enclosures for conductors, and for equipment, shall be not less than that given in the preceding table.

Care should be taken that the equipment ground (permanent and continuous bonding together of conductor enclosures, apparatus frames and non-current carrying parts of the system) has an impedance low enough to facilitate operation of the overcurrent devices in the circuit before a fault ground develops into a phase-to-phase fault. In large capacity systems, red lead should be used on conduit joints; the finish should be scraped off bus duct enclosures at joints to assure low-resistance contact; if necessary, bus sections should be bonded with copper

cables of at least 25% the capacity of the main circuit; each section of all switchboards should be bonded to the main grounding bus.

2.52 Grounding Large Buildings

Transformer tanks, three-position disconnecting switches, cubicle framework; ground bus in cubicles; cable supports and non-current carrying metallic parts of all equipment and conduits shall be securely grounded by connection to a common ground bus insofar as practicable and ground bus shall be connected to nearest water pipe. Ground connections shall not be less than 1/0 copper, connected throughout with clamp fittings. No soldered connections shall be used in leads.

The neutral point of all secondary windings of all network or lighting transformers shall be connected to a separate grounding system. The neutral leg of the main bus at the various main switchboards shall also be connected to this ground bus at the switchboard. The ground bus and connections shall be not less than 500 MCM bare copper wire, and same shall be connected to the nearest cold water pipe. Connections shall be made to this pipe with a copper or brass pipe clamp. These connections shall be made on the street side of the water meters, or jumpers shall be installed by-passing all meters. A complete system shall be installed for each vault, and same shall be in accordance with the latest edition of the National Electrical Code. All ground conductors, and

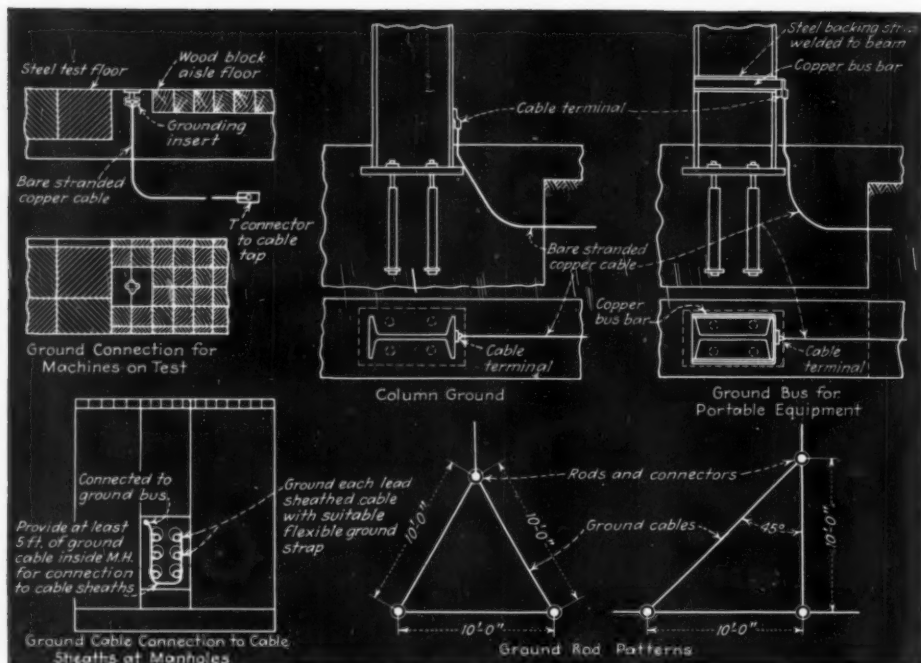
taps from equipment to bus shall be made with copper, with as few connections as possible.

Bus shall be continuous without joints or splices throughout its length. All connections from bus to taps, and bus to bus shall be made with an approved type of solderless connector, and all grounding conductors shall be protected from mechanical injury, and shall be rigidly supported. If ground conductors are run through conduit they shall be securely bonded to such conduit at the entrance and exit. All connections to equipment or conduit shall be made with an approved type of solderless connector, and same shall be bolted or clamped to equipment or conduit. All contact surfaces shall be thoroughly cleaned and bright before connection is made so as to insure a good metal to metal contact.

No ground wires smaller than No. 8 shall be used, and all wires larger than No. 8 shall be bare copper cable.

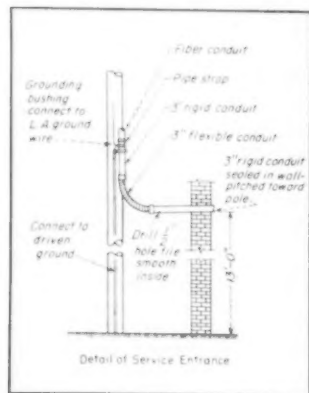
2.53 Grounding Small Buildings

Ground connection shall be made by connecting one end of a wire to the neutral service conductor at main switch and the other end to the cold water pipe where shown on plans. Ground wire shall be same kind and quality as other conductors in the building, shall be placed in steel conduit run as specified for branch circuits, and shall be of a size required by the National Electrical Code. Where the ground connection is made to the water pipe on house side of



Grounding details, like these, should be clearly stated in specifications and shown on accompanying plans.

water meter, a jumper or shunt shall be installed around the water meter. The current-carrying capacity and mechanical protection shall be not less than required for the grounding conductor. Where a grounding conductor runs through metallic conduit, it shall be securely bonded to the conduit at the entrance and exit and the conduit shall be fitted with a bolted clamp to secure same to water pipe.



Grounding cable: Lead sheaths of underground cables shall be bonded together and grounded at each manhole. Primary underground feeder systems shall include a 500,000 CM bare conductor installed in the duct system and connected to a driven ground rod in each manhole and to underground water piping as shown on the drawings.

Grounding metal clad assemblies: Provide a ground bus with a cross-section equal to at least 25% of the capacity of the largest circuit. Housings shall be bolted securely to the bus.

2.54 Grounding Assemblies

Driven grounds are used where other types of grounding facilities are not available.

Grounding shall be accomplished by means of "grounding assemblies." The single rod assembly shall consist of one — ground rod, — inch diameter and — feet in length; a — clamp at the top of each rod; and a bare stranded copper conductor from the clamp to the equipment to be grounded.

The three-rod assembly shall comprise three — ground rods, each — inch diameter and — feet in length, spaced in the form of an equilateral triangle with rods 6 feet apart; a clamp at the top of one rod; a bare stranded copper conductor from one of the clamps to the equipment to be grounded; and a bare stranded copper conductor circling the three rods and brazed to each one. Upper ends of the rods shall terminate 6 inches above the established grade.

Grounding conductors forming the loop of the three-rod assembly and the lead from the three-rod and single-rod assemblies shall be bare stranded copper cable installed 2 feet underground from the rod to which it is attached, to the structure or equipment to be grounded. The grounding conductor shall be brazed or bolted to the structures or equipment as directed by the engineers.

The resistance between the ground cable and absolute earth shall not exceed — ohm and shall be measured in the presence of (authoritative personnel) before equipment is placed in operation.

3.1 Transformers

3.11 Transformer Stations

Transformer installations permit the use of higher distribution voltages stepped down to utilization voltages at or near load centers. They may also provide lighting and small tool voltages from higher voltage power distribution systems.

Two developments have greatly expanded the range of practical application of transformers in interior wiring systems:

a. The metal clad unit power center or substation, a combination of transformers and switchgear fully self contained and protected and designed for free standing installation in industrial plants and large buildings without vault protection.

b. Dry type distribution transformers which require no special enclosures and may be installed in practically any indoor location.

Transformers may be installed to operate on primary feeder distribution systems of various voltages.

Installation design details must conform to the National Electrical Code and local or state regulations. They must also meet the approval of the power supply company.

Types of stations which may be considered are:

a. Single stations supplied by primary service conductors.

b. Master stations supplied by primary service conductors, and which in turn supply two or more transformer substations located in various parts of the customer premises.

c. One or more transformer stations located in various parts of the customer premises, all served by a primary distribution network.

d. Unit substations designed for installation within buildings without vault protection.

Transformer stations may be located:

a. In metal clad unit substations.

b. Upon the building roof.

c. Attached to the outside of the building.

d. Placed on the ground in suitably guarded enclosures or in underground vaults.

e. Installed above the ground upon poles or other approved supporting members.

f. In one or more approved rooms or vaults in the building.

g. On balconies or elevated platforms above load centers.

h. Along walls or between columns near working areas.

i. In basements beneath production floors.

The principal electrical requirements to be described are:

a. Interrupting capacity of primary switchgear.

b. Size, capacity of transformer.

c. Disconnecting devices.

d. Lightning arresters.

e. Grounding networks.

f. Secondary control devices.

g. Service and inside wiring, clearances, bus structures.

h. Control and metering transformers and connections.

VOLTAGE DESIGNATION OF ELECTRICAL SYSTEMS AND RELATED EQUIPMENT VOLTAGE RATINGS

Note the preferred voltages for new installations.

Nominal System Voltage	Generator Rated Voltage	Transformer Secondary Rated Voltage	Transformer Primary Rated Voltage	Motor Rated Voltage	Lamp Rated Voltage
Single-phase					
120 or 120/240	120 or 120/240	120 or 120/240	120	115	118 or 120
240 or 120/240	240 or 120/240	240 or 120/240	240	230	236
Three-phase					
120	120	120	120	110	118 or 120
*208Y/120	208Y/120	208Y/120	208 or 120	208 or 110	208 or 118 or 120
240	240	240	240	220	236
*480	480	480	480	440	265
600	600	600	600	550	
*2,400	2,400	2,400	2,400	2,300	
*4,160	4,160	4,160	4,160	4,000	
4,800	4,800	4,800	4,800	4,600	
*6,900	6,900	6,900	6,900	6,600	
11,500	11,500	12,000	12,000	11,000	
12,000	12,500	12,000	12,000	11,000	
13,200	13,800	13,200	13,200	13,200	
*13,800	13,800	13,800	13,800	13,200	
22,900			22,900		
34,400			34,400		
43,800			43,800		
67,000			67,000		
110,000			110,000		

*In new installations, or wherever a selection of voltage can be made, these are the preferred system voltages.

Power Centers

Incoming high voltage circuit connections shall consist of a 3-pole 2-position (open-close) disconnecting switch and pothead with uncut wiping sleeve arranged for bottom connections. This switch shall be key interlocked with the feeder circuit breaker to prevent it from interrupting load current. Equipment shall have — kva interrupting capacity at — kv, — amps. (or it shall consist of cover bush-

Incoming circuit connections shall also include strain frame mounted on cover of transformer for dead-ending the high-voltage incoming lines.

Voltage transformation section shall be rated for —/— kva, oil insulated (or Askarel filled, or air cooled, etc.), 3-phase 60-cycles, — volts delta primary, — volts wye secondary, with solidly grounded neutral.

High voltage windings shall be provided with 2½% taps, two above and two below normal, with externally operated manual tap changer handle arranged for padlocking in each position. Taps may be changed only when transformer is de-energized. They provide means for adjusting to average supply voltage.

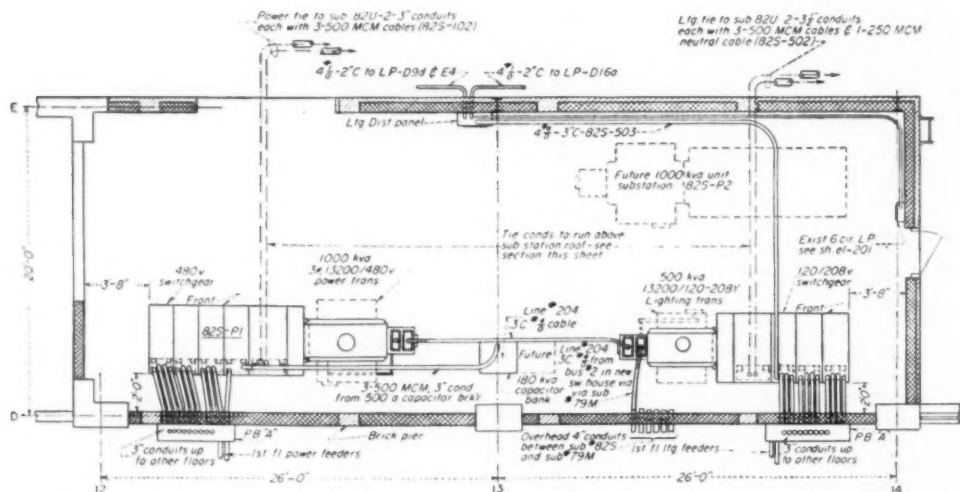
Automatic tap-changing equipment for operation under load shall be installed on low voltage side to maintain constant voltage on low-voltage terminals (or some point on the feeder).

Voltage transformation section shall include contact-making voltmeter, line-drop compensator and necessary auxiliary control mount-

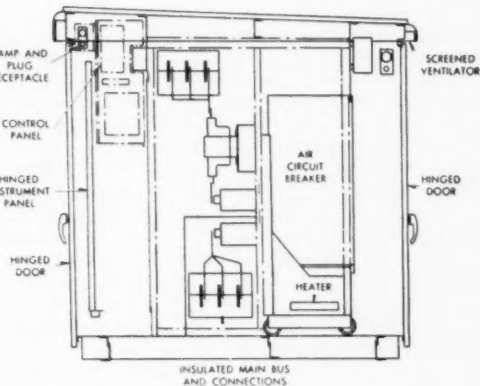
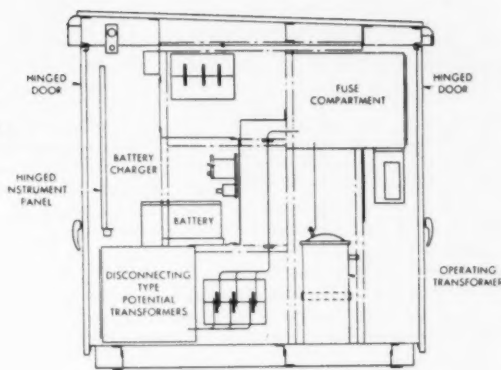
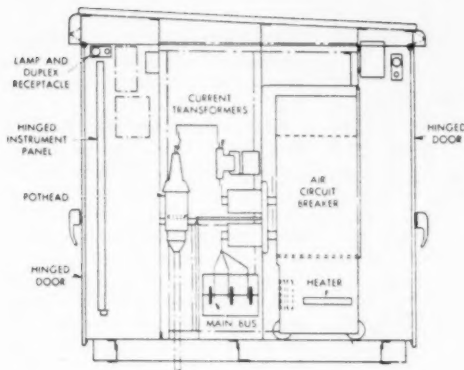
ed on a hinged steel panel within the unit substation. A rotary switch for selecting automatic or manual control shall be provided. Current transformer for line-drop compensator will have 0.2-amp secondary and be located under oil in the transformer. Potential for the contact-making voltmeter shall be obtained from a potential transformer in the switchgear and power to drive the mechanism from the switchgear control power transformer. An operation counter and position indicator shall be included. Reactance portion of the line-drop compensator shall be provided with a reversing switch for parallel operation with other units.

Gas-oil sealed tank shall be equipped with drain and sampling valves, filter press connections, magnetic oil gauge with alarm contacts, relief diaphragm, ground block and top-oil dial type thermometer. It shall also have nameplate, delta-wye terminal board, neutral bushing, provision for future addition of automatically controlled fans to give continuous overload rating of — kva.

(If transformer is air cooled, transformer shall be of the dry type, insulated with Class "B" material and shall carry full rated load continuously without exceeding 80° C rise above an ambient temperature of 40° C when cooled



80



by natural air circulation. Transformer shall be enclosed in sheet metal case which shall match and line up with the high- and low-voltage switchgear. Taps shall be brought to a terminal board accessible by removing a panel.)

Outgoing feeder switching section shall include — potential transformers, drawout type — /120 volts, with fuses of current-limiting type (for reclosing relay of transformer secondary breaker and load-ratio control equipment); Pyranol control power transformer — /115/230 volts with drawout fuses of the current-limiting type (for main power circuit breaker and load ratio control equipment); 115 volt 250 watt heater, and light switch, light outlet and convenience outlet receptacle.

Outgoing feeder section shall also include oilless circuit breaker, vertical lift, — amps, —kva interrupting capacity, 220 volts ac rectifier solenoid operated, necessary auxiliary switches, latch checking switch, control relay, over-current relays, reverse-power relays, etc. Breaker shall be complete with mechanical interlocks, primary and secondary disconnecting devices.

Low voltage feeder switchgear shall consist of — radially connected circuit breakers, — volts, — amp interrupting capacity, manually operated, drawout type, mounted in dead-front steel hinged-front compartments with removable rear plates, copper busses and provision for bolting to other sections in the field to form an integral unit. Drawout low-voltage

Section views through the feeder unit auxiliary compartment and secondary breaker section of an outdoor metal-clad air circuit breaker switchgear assembly.

breakers shall be equipped with safety interlocks to prevent withdrawal or insertion of breakers when they are in the closed position, manual trip buttons, external visual indicators showing breaker position, arc quenchers and insulated closing handle for manual operation.

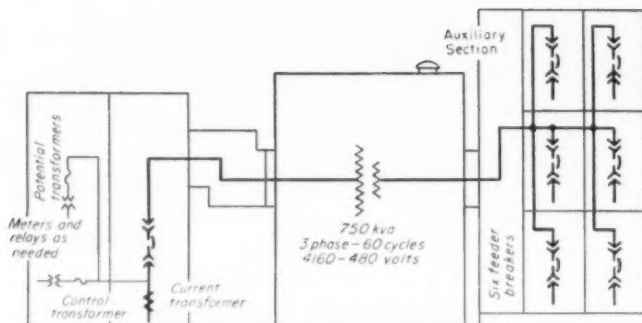
3.12 Dry type Distribution Transformers

Individual dry type transformers of the general purpose type (120/240 volts) are most frequently used for industrial applications for taking lighting or special appliance loads from power circuits of 240, 480 or 600 volts. Normal ratings run from 1½-kva to about 500-kva. Their advantages are being recognized by more and more users of power, for they can operate close to load centers, require little attention, minimize distribution losses, eliminate the need for separate low-voltage power circuits, provide power

for small motors at a lower utility rate, reduce copper costs and secure improved voltage regulation.

Dry type units cannot explode, they reduce fire hazards to a minimum, they are small in size, light in weight and do not require the construction of vaults.

In locating a dry type transformer, thought should be given to accessibility, ease of inspection, surrounding structural conditions and prevailing humidity. Since these units depend upon the surrounding air for cooling, clean, dry air is essential to provide adequate ventilation and, whenever possible, filtered air should be recommended. Surrounding air should be such that the average ambient temperature does not exceed 85° F. Transformers should be so located that water cannot fall on the case, also, dusty atmospheres, corrosive liquids and gases must be absent. To permit free air circulation, dry type transformers must be separated from one another by from 1- to 3-feet, depending on their size



Typical load center consisting of liquid-filled transformer, high voltage switchgear and auxiliary unit with circuit breakers can be located close to the point of requirement.

and, also, they must be separated from walls and partitions.

Because their noise level is higher than liquid-filled transformers, dry type units should not be installed in places where the noise would be objectionable, such as in offices.

Small dry type transformers can be specified for either single-phase or 3-phase use. In general, single-phase units are less expensive and more adaptable, but three-phase units are used when 3-phase 208-volt power is required for the operation of small motors. Single-phase units are connected line-to-line on a 460-volt system, and arranged for 120/240 three-wire single-phase on the secondary. Three phase units are connected delta on the 460-volt side and 208Y/120-volt 3-phase

4-wire on the secondary side. With voltage taps now available in the primary windings of dry type units, these units can be used to deliver almost exact voltage requirements.

Transformers

Distribution transformers shall be air insulated and air cooled, — phase, and shall transform — volt, — phase, — cycle, — wire current on the high side to — volts, — phase, — cycle, — wire current on the low side. Capacities shall be as shown on accompanying plans and schedules. Units shall be conventional (completely self supporting, subway, etc.) type, suitable for indoor (outdoor, vault, etc.) service and shall be arranged

for wall (pole, floor, etc.) mounting as shown on the plans. Four $2\frac{1}{2}\%$ taps shall be provided on the high voltage windings, two taps above and two taps below normal.

High voltage bushings shall be stud (pothead, wiping sleeve, etc.) type, cover (or sidewall) mounted. Low voltage bushings shall be stud (etc.) type, cover mounted. All bushings shall have suitable gaskets to provide a tight fit.

Transformers shall be guaranteed against load and total losses, and the limiting dimensions and net and shipping weights, also the regulation at 100% and 80% power factor shall be given. Testing shall conform to A.S.A. transformer standards, and units must meet all A.S.A. Acceptance tests.

Individual high-voltage and low-voltage coils shall be wound on separately formed barriers in order to facilitate removal of the coils in case of repairs being required. Windings shall consist of copper coils suitably insulated, thoroughly dried and vacuum treated.

Core shall be manufactured of high-grade non-aging sheet-steel laminations, properly annealed, treated and insulated from each other in accordance with approved practice.

Nameplate shall list make, serial number, type, style, form, kva, voltage ratings, percent taps, cycles, phase, polarity and impedance.

4.1 Panelboards and Safety Switches

4.11 Service Entrance Switches

Service entrance switches shall be furnished and installed as shown and described in the plans and riser diagram. Switches shall be rated and approved as suitable for use as service equipment.

Service entrance switches shall comply with the requirements of the Underwriters' Laboratories and of the National Board of Fire Underwriters for enclosed switches or for service equipment and each switch shall bear manufacturer's name and the Underwriters' Laboratories' label. Enclosures shall be of suitable material and design for the surrounding conditions.

Fuse types shall be so interlocked with the external switch handle that the door cannot be opened except when the switch is in the "off" position and that the switch cannot be placed in the "on" position except when the door giving access to fuses is closed. Further, when this door is open no uninsulated live metal terminal or other live metal parts whatsoever shall be accessible. (Indicate whether switch shall be provided with meter trim, meter test facilities, etc.)

Service switches shall be type A construction with quick make and quick break operation.

Service entrance breakers: The service entrance switch shown shall

be of the enclosed circuit breaker type. Breaker shall be manually operated, trip free and designed so that all poles open simultaneously. Overload tripping mechanism shall be (thermally operated, magnetically operated) and arranged to provide effective sealing against tampering. Breakers shall be approved by the Underwriters' Laboratories, Inc., and acceptable under the regulations of the local utility for service entrance use.

4.12 Panelboards, Fused

Furnish and install as shown on plans and indicated in the riser diagram distribution and branch circuit panelboards equipped with

switches and fuses of the capacities noted.

Panelboards shall be dead front and enclosed in a code gauge steel box. Trim shall be flush or surface type as shown. Doors shall be equipped with spring latches. (Indicate whether locks are required and whether locks should be identical for all panels.)

Panelboards shall be of standard types and the product of established manufacturers. The capacity of switches and fuses shall be as shown. Each circuit shall be provided with fuses in all poles except neutral.

Pull out type switches shall be dead front when closed and fuses shall be dead in the open position. Branch circuit panels shall be dead front with switches and fuses. Switches shall be heavy duty tumbler type.

a. Distribution panels shall be unit construction dead front safety type. Switches shall be quick make and quick break. Fuses shall be accessible only when the switch is in the open position.

b. Distribution panels shall be unit construction dead front with pull-out type fusible circuits. Fuses shall be inaccessible until completely cleared from contact with the mains. Units shall have provisions for testing fuses.

4.13 Panelboards with Circuit Breakers

Branch circuit panelboards shall be the dead front safety type equipped with circuit breakers. Bus bars shall have lug connections for attaching feeders and arranged for wire mains and two wire branches, unless otherwise noted on drawings. The grounded side of each branch circuit shall be fed direct from the neutral bus bar. The circuit breaker shall control the ungrounded side.

Distribution panelboards shall be of the dead front safety type equipped with circuit breakers. Bus bars shall have lug connections for attaching feeders. The sizes of circuit breakers shall be as noted on drawings and unless otherwise noted shall be double pole for 3 wire single phase or 3 pole, for 4 wire, 3 phase 208 volt circuit breakers, with the neutral connected to common bus bar.

Circuit breakers shall be of the (thermal, thermal-magnetic, hydraulic-magnetic) type.

4.14 Switchboard with Circuit Breakers

Switchboard shall be the dead front safety type consisting of panels and circuit breakers of the number and sizes shown on the drawings. The construction shall consist of a structural or formed steel frame carefully built into a rigid structure which shall maintain its alignment and not be damaged in shipment or erection or by stresses resulting from short circuits. The frame shall be completely enclosed on front and sides with sheet steel plates. Adequate ventilation shall be provided. A pull box of the same type of construction shall be provided at the top of each switchboard which shall match the switchboard in dimension and finish. Bottom of pull box shall be non-combustible insulating material and cables to circuit breaker studs dropped vertically through individual openings in bottom to their respective studs. Switchboard shall be sectionalized to permit access to the breakers.

Bus on switchboard shall be of hard drawn copper of 98% conductivity. Connections shall be bolted and laminations interleaved to secure maximum contact areas. All laminations shall have a 1/4 inch space between them. All buses and circuit breaker stub connections shall be of such size as to limit the temperature rise to 30° C. when carrying full-load current at room temperature, but not to exceed a current density of 1000 amperes per square inch. Buses shall be arranged for distribution as shown on drawings.

4.15 Cabinets

All cabinets shall be made of sheet steel. Cabinets for panelboards shall provide proper space for all wires and connections.

Cabinets for telephone terminal strips and connection points shall be of sizes and depths noted on plans.

Cabinets shall be of standard make and shall bear the manufacturer's name plate or stamp and the Underwriter's Laboratories' inspection label.

Fronts for flush cabinets shall consist of sheet steel frame and a hinged door with catch and lock. Frame shall be about 3/4 inch larger than cabinet on all sides and shall be set with its back flush with the finished wall.

Telephone and signal cabinets for surface mounting shall be equipped with a door hinged directly to cabinet. Door shall be made of one piece of sheet steel and shall have a 3/4 inch flange around all edges shaped to cover edge of box and equipped with catch and lock.

Lighting and power cabinets for surface mounting shall be equipped with a sheet steel frame and hinged door with catch and lock. Frame shall be the same size as cabinet and shall completely cover wiring gutter.

Each cabinet shall be furnished with a catch and flat key lock. All locks shall be fitted to the same key. Furnish keys for each job.

All cabinets shall have proper means for securing, supporting, and adjusting the panelboards and fronts. Cabinets shall be arranged to provide a wiring gutter not less than 3 inches wide for panelboards up to 31 inches high and not less than 4 inches wide for larger panelboards.

Lighting and power cabinets shall be installed with tops 6-feet 6-inches above floor, and telephone cabinets shall have bottom just above baseboard. Telephone and signal cabinets in ground floor shall be installed with tops 6-feet 6-inches above floor, unless otherwise noted on drawings. Those in finished spaces shall be set flush in walls and those on unfinished walls or where shown on drawings shall be set exposed. All cabinets shall be rigidly secured in place. All cabinets shall have fronts straight and plumb and arranged so that panelboards will be centered in door opening. Telephone cabinets over 30 inches wide shall have double doors.

Double-pole, 2 blade for 3 wire, single phase or 3 pole, 3 blade for 4 wire 3 phase, 250-volt switches with neutral connected to common busbar at top of panel will be acceptable for distribution panelboards when grounded neutral systems are installed.

The mains of panelboards shall be furnished with lugs only unless otherwise indicated.

4.16 Motor Disconnecting Switches

Safety type motor disconnecting switches shall be Type A enclosed, 230-volt unless otherwise noted, rated in horsepower capable of interrupting the locked rotor current of the motor for which it is to be used, which current will be assumed six times the rated full load current.

4.18 Fuses

Protective devices for circuits not over 125-volts to ground and not over 30-ampere capacity shall be of the plug type and shall be of such a type and so designed as to be subject to tampering or bridging only with difficulty.

a. Fuses shall be one time, standard type, accurately rated, as made by — or approved equal.

b. Fuses shall be of the time delay type; capable of holding 200% load for 30 seconds; as made by — or approved equal.

All other circuits shall be protected by cartridge fuses (one time, renewable)

a. Of standard type, accurately rated.

b. Time delay type, capable of holding 500% load for 10 seconds, as made by — or approved equal.

All such fuses to bear the label of Underwriters' Laboratories, Inc. They shall be properly stored and protected until installed.

Spares amounting to one-half of a duplicate set of those installed shall be turned over to the owner upon completion of the building.

5.1 Feeders

5.11 Riser Diagrams

Lighting and power feeders should be shown on a riser diagram giving the size of conduit, size and number of conductors, type of insulation, location of pull boxes, tapes and terminals, method of support and routing details. This information can either be detailed on the riser diagram or can be included in a tabular listing of the feeder specifications and description of the terminal points.

Distribution inside the building shall be 3-phase 440-volts 60-cycles 3-wire ac for power and 3-phase 4-wire 120/208-volts for lighting.

From the main switchboard, separate feeders for power and light shall be run and connected to the various cabinets, panels and switches throughout the building as shown on the riser diagram. Feeders shall be of sizes and types of wire as shown on the drawings and shall be installed in steel conduit run exposed on racks supported by hangers secured to structural beams and slabs. Cable supports in riser shafts shall be of the split wedge type construction, as manufactured by —, or equal.

Any deviations from the drawings shall be checked with the supervising authorities and with other mechanical trades to avoid interference.

Wherever practical, feeder conductors shall be continuous without splices between terminals. All conductors of a circuit shall be contained in the same raceway.

5.12 Carrying Capacity

Every feeder and subfeeder should have a carrying capacity at least sufficient for the current corresponding to a maximum demand.

Compute the standard load for general illumination from the standard load in watts per sq. ft. and the area of the space served. Add to this load 1000 watts for each circuit specified herein for purposes other than general illumination and 500 watts for each spare panelboard circuit, and any specific other load not otherwise included.

5.13 Voltage Drop

Feeder and subfeeders shall be of such size that, at a load corresponding to the maximum demand computed as stated above, the total voltage drop from the service entrance to any panelboard will not exceed 1.5%.

Provision should be made for a future increase in the capacity of the feeder system to provide for a load of 1,500 watts on each 15-amp branch circuit installed so that, at such increased load, all feeders will have sufficient carrying capacity and the voltage drop will not exceed 1.5%.

Provisions for future capacity may be provided:

1) By installing feeders of excess size as a part of the original installation. This method should be employed in every case where conductors not larger than No. 4 are required to meet the requirements for carrying capacity and voltage drop at the increased load.

2) By installing oversize raceways, so that the conductors originally installed may be withdrawn at any time and replaced by conductors of suitable larger size.

3) By making suitable provision so that additional feeders can be installed at a minimum of expense to provide the additional capacity.

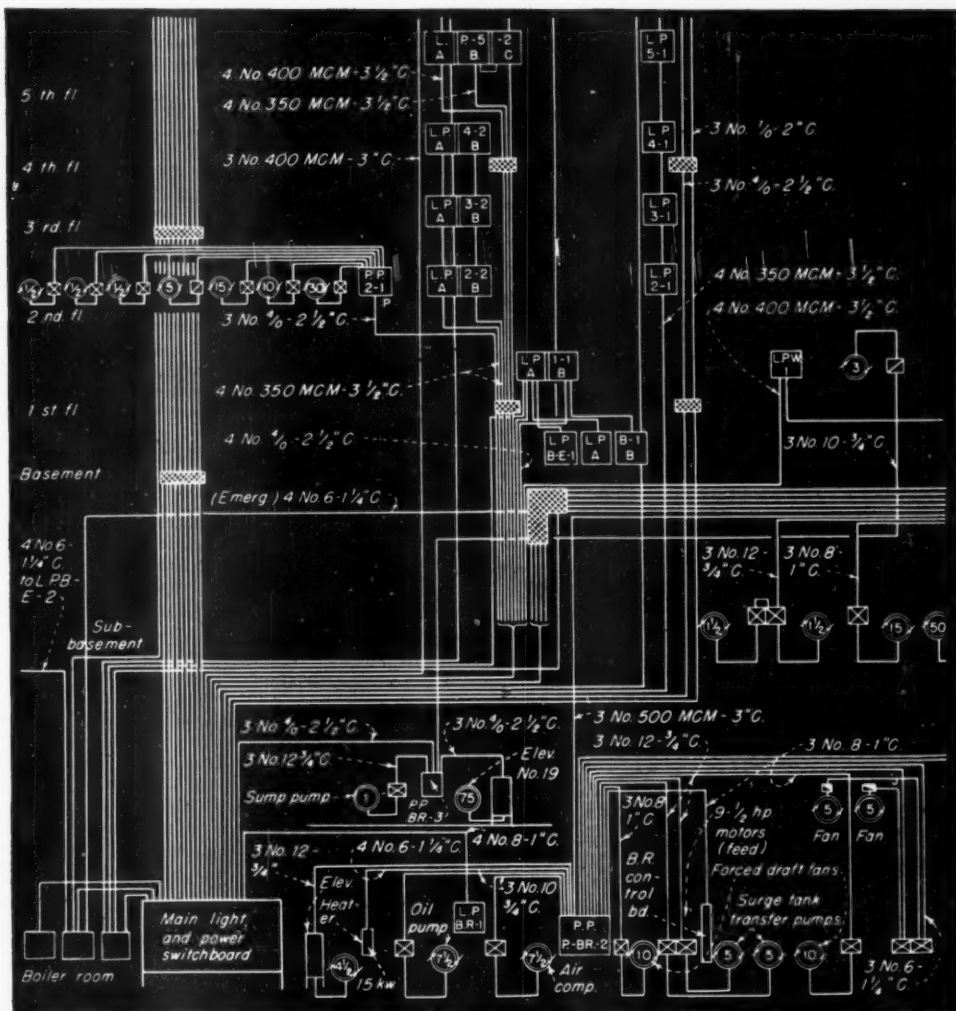
Where either method 2 or 3 is used, provision should be made at the feeder distribution center so that any larger feeders or new feeders installed can be properly controlled and protected without involving excessive expense for remodeling the original equipment.

Where method 3 is used, the system should be carefully designed so that the supplementary conductors can be used as separate feeders, not connected in multiple with the original conductors. Wherever these supplemental feeders must pass through walls, floors, or inaccessible places, suitable raceways should be installed when the original installation is made or work is in progress.

At feeder distribution centers, each feeder should be controlled and protected by a switch and fuses or by a circuit breaker.

5.14 Conduits

All wiring shall be run in galvanized rigid steel (or aluminum) conduit and galvanized flexible conduit as shown on the contract drawings and as hereinafter specified. Conduit shall be made of new standard weight pipe; each tube used in the manufacture of steel



Portion of riser diagram indicates arrangement of panels, controls and motors with relation to main light and power switchboard.

conduit being mild steel, having a smooth circular bore, with seams thoroughly welded, permitting the cutting of clean, true threads. Straight conduit shall be delivered to the job site in lengths not less than approximately ten (10) feet, unless otherwise approved by the engineer in charge. Each length of conduit, including factory-made elbows, shall be threaded on both ends and each end shall be reamed to remove burrs and sharp edges. The pitch and shape of thread shall conform to the American Standard pipe thread. Taper shall

be constant and continuous for the total length of thread.

Couplings and conduit unions shall be of galvanized steel, shall have the conventional dimensions of the trade and shall be internally threaded with a tapered thread at each end to fit the tapered thread specified for the corresponding size conduit.

All outlet boxes shall be of galvanized cast iron (or stamped aluminum) with conventional knockouts of type and size for each particular use. Fittings not specifically called for on the contract

drawings but required to complete conduit runs shall be installed subject to the approval of the engineer.

The inside and outside of all steel and flexible conduit, including factory-made elbows, and of all boxes and fittings, including bolts and screws (except fittings and other accessories elsewhere specified to be made of silicon bronze) shall be protected against corrosion by an even coating of zinc applied by the hot-dip process. Before galvanizing, all surfaces shall be cleaned. The cleaning

process shall leave the surface in such a condition that the zinc coating will be firmly adherent and will be smooth. Galvanizing shall withstand standard American T & T tests for hotdip galvanizing.

The inside surface of steel con-

duit, including factory-made elbows, shall be given a smooth coat of baked enamel after galvanizing. Enameling and galvanizing shall not crack or flake when the conduit is bent at right angles on a radius equal to eight times its in-

side diameter. Enameling and outside treatment shall be smooth, hard and flexible.

Where exposed conduit needs clamping to the structure, clamps shall consist of galvanized malleable iron one-hole pipe straps, clamp backs, steel bolts of appropriate size to fill the holes in the straps and clamp backs, and approved expansion shields. Clamps shall be bolted to the structure or where necessary to intermediate steel brackets as indicated. No deformed, split or otherwise defective conduit or fitting shall be installed. Conduit shall be installed with a minimum number of joints.

Where conduit has to be cut in the field, it shall be cut square using a hand or power hacksaw or approved pipe cutter using cutting knives. The use of pipe cutters with cutter wheels will not be permitted. The cut ends of the field-cut conduit shall be reamed to remove burrs and sharp edges. Where threads have to be cut on conduit, the threads shall have the same effective length and shall have the same thread dimensions and taper as specified for factory cut threads on conduit. Conduits installed in the work with threads not complying with these requirements shall be removed and replaced.

Conduits shall be joined by means of couplings or conduit unions. Joints shall be set up tight. Runs shall be straight and true; elbows, offsets and bends shall be uniform and symmetrical. Installation workmanship shall be of the best quality and skill.

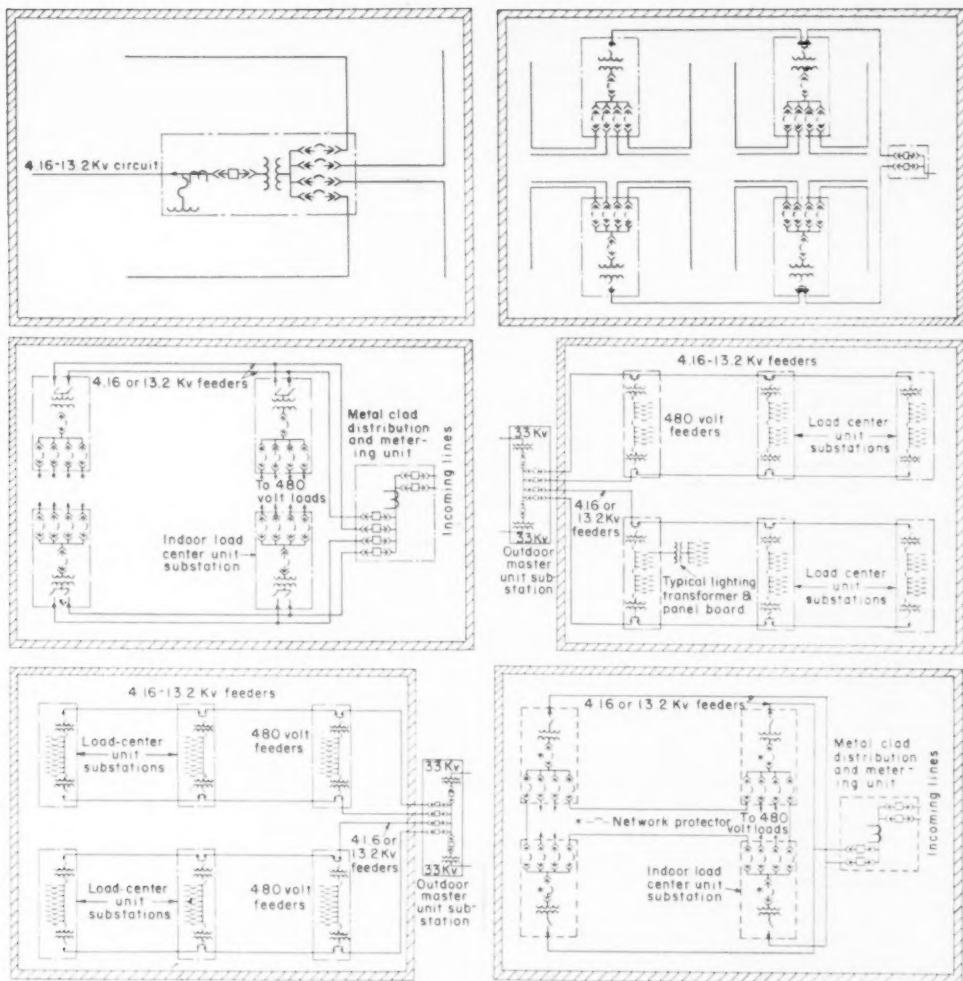
All conduit shall be cleaned, prior to pulling in wire and cable, by pulling a stiff wire brush of the size of the conduit through it. This cleaning shall remove all foreign matter, including water, from the conduit. All boxes in which the conduit terminates shall be cleaned of all concrete, mortar or other foreign matter and all threads in boxes shall be left clean and true upon completion of the work.

Wireways shall be an approved type and installed according to the recommendations of the manufacturer, complete with all necessary fittings, connectors and parts. All parts shall be of the same make and shall be assembled accurately and supported firmly.

BUSDUCT DESIGN CHECK LIST

The following check list will serve as a guide both in laying out the system and in making sure all important data is included.

1. Indicate the system (1 phase, 3 phase, 3 phase 4 wire, etc.) and voltage, giving feeder or plug-in duct designations.
2. Work from floor and elevation building plans.
3. Make use of standard symbols for both detail and single-line layout drawings.
4. Estimate greatest future load anticipated.
5. Show existing and anticipated power factor and demand factor.
6. Record transformer total kva capacities and impedances.
7. Locate transformers or main switchboard in such a manner that they will be near or at the center of distribution. This makes possible shorter runs, lower resistance loss, minimized voltage drop and greater flexibility when changing equipment locations.
8. Give cable sizes and number of lugs per leg when cable and duct are combined in the same system.
9. Spot position of all motors if possible, giving motor capacities in horsepower and application (such as press, lathe, power punch, etc.).
10. Indicate type of motor such as squirrel cage, induction or synchronous. Also indicate type and load characteristics of any other electrical equipment (such as welders, ovens or furnaces).
11. Determine the best possible hanger arrangement and mounting facilities.
12. Locate duct so that motor branch circuit distances are 30 feet or less from the plug-in tap-off device to the motor location.
13. Where no elevation plans are available, designate risers or drops and indicate number of feet each extends.
14. Detail all unusual fittings such as special offsets, jogs or combinations of fittings.
15. Indicate type of building, such as steel truss, crane way or high bay, saw tooth, pitched roof, flat roof, flat roof beam, mill type with wood or reinforced concrete.
16. Where concrete in various forms is used, indicate steel pan, hollow tile, beam type and reinforcing.
17. Clear I-beams, pipes, and other obstructions when passing through walls, floors and ceilings.
18. Where concrete, steel, wood or plaster must be broken through, mark plainly.
19. Expansion joints should be considered for bus duct runs exceeding 150 feet in length, and obviously must be provided wherever expansion joints occur in the building structure.



Unit substations with various arrangements of high voltage, transformer and low voltage equipment may be incorporated into radial, selective and network distribution systems.

Armored Cable Feeders: Feeders shall be run in armored cable of approved type and manufacture. Sizes shall be as indicated on the feeder schedule. Cables shall be multi-conductor and the sheath shall enclose all conductors of the circuit. Splices shall be made in approved fittings or junction boxes. Fittings and connectors shall be made up tight to provide a firm mechanical connection.

Cables shall be strapped in place on girders and columns, following the structural members closely. Where cables cross open areas they

shall be firmly supported by $\frac{3}{8}$ -inch steel messenger wire in the manner detailed on the drawings.

5.15 Wire and Cable

The selection of wires and cables is one of the most important in the specification of an electric wiring system. The size and routing of the conductors determine the ultimate electrical capacity and energy distribution through the project. The quality of insulation determines its useful life.

Code tables designate maximum safe current-carrying capacity of conductors

based on size and type of insulation. Important economies can often be made by selecting insulations capable of withstanding higher temperatures, such as RHH.

On both feeder and branch circuits, voltage drop considerations often require larger conductors. Maximum permissible voltage drop should be determined and the losses allocated over the various parts of the system.

As a general rule, liberal oversizing of wires to allow for future loads and the best quality of insulation provide ultimate values far beyond their small additional cost.

1951 CODE DEMAND FACTORS

Type of Occupancy	Unit Load Per Sq. Ft. (Watts)	Load to which Demand Factor Applies (Watts)	Demand Factor
Armories and Auditoriums	1	Total Wattage	100%
Banks	2	Total Wattage	100%
Barber Shops and Beauty Parlors	3	Total Wattage	100%
Churches	1	Total Wattage	100%
Clubs	2	Total Wattage	100%
Court Rooms	2	Total Wattage	100%
Dwellings— (other than Hotels)	3	3,000 or less Next 117,000 Over 120,000	100% 35% 25%
Garages—Commercial (storage)	1/2	Total Wattage	100%
		50,000 or less Over 50,000	40% [†] 20%
Hospitals	2	Total Wattage	100%
Hotels, including apartment houses without provisions for cooking by tenants	2	20,000 or less Next 80,000 Over 100,000	50% [†] 40% 30%
Industrial Commercial (Loft) Buildings	2	Total Wattage	100%
Lodge Rooms	1 1/2	Total Wattage	100%
		20,000 or less Over 20,000	100% 70%
Office Buildings	2	Total Wattage	100%
Restaurants	2	Total Wattage	100%
		15,000 or less Over 15,000	100% 50%
Schools	3	Total Wattage	100%
Stores	3	Total Wattage	100%
		12,500 or less Over 12,500	100% 50%
Warehouses, Storage	1/4	Total Wattage	100%
In any of above occupancies except single-family dwellings and individual apartments of multi-family dwellings:			
Assembly Halls and Auditoriums	1	Total Wattage as specified	
Halls, Corridors, Closets	1/2	for the specific occupancy	
Storage Spaces	1/4		

[†]For sub-feeders to areas in hospitals and hotels where entire lighting is likely to be used at one time; as in operating rooms, ballrooms, dining rooms, etc., a demand factor of 100 per cent shall be used.

Wires and cables of the size, wire number and type shown on the contract drawings and included in the accompanying schedule shall be furnished and installed as hereinafter specified.

All wire and cable, unless otherwise specified, shall be 600-volt rubber insulated of the heat-resistant RH type, shall conform to all of the latest requirements of the National Electrical Code, and meet all specifications of the ASTM. Conductors shall be thoroughly tinned soft drawn copper (or aluminum). Braid shall be flame-proof.

The minimum size of wire for lighting or power shall be No. 12.

All branch circuits more than 100 feet in length shall be No. 10 for the entire distance up to the first outlet. Control circuits shall be No. 14, except for runs exceeding 300 feet, where they shall be No. 12. Wire sizes No. 14 to No. 8 shall be solid except as otherwise indicated. Wire sizes No. 6 and larger shall be stranded, double braid. All sizes called for in the specifications or shown on the contract drawings are American Wire Gauge sizes.

All sizes of wire and cable shall be factory color-coded, with a separate color for each phase and neutral used consistently throughout. The grounded wire of all branch circuits shall have a white braid

and all connections to single pole switches shall be so made that the operation of the switch opens the outside leg. Cable shall be manufactured by — since (month and year). They shall be suitably protected from weather or damage during storage and handling and shall be in first class condition when they are installed.

Wiring within boiler rooms and incinerator rooms or runs without three (3) feet of heating pipes shall be Type AVA, impregnated asbestos and varnished cambric insulated.

Wiring run in basement floor slabs and in all runs exposed to moisture or weather, lights and underground service feeders, such as branch circuits to outside shall be Type TW waterproof grade (or RW, lead covered, etc.).

The installation of wires and cables include all splicing of these wires and cables to each other and connecting them to switchboards, receptacles, switches, control boxes, lighting fixtures, motors and all other electrical apparatus installed under this contract.

No wire shall be drawn into conduit until all work which may cause injury is completed and until permission is given by the supervising engineer in writing. Powdered soapstone only shall be used as a lubricant where necessary.

Where feeders consisting of multiple conductors per phase pass through pull boxes or panels each conductor of one phase shall be grouped together with the other two phases to reduce the reactance effect. Limiter lugs shall be provided where required by the N. E. Code.

Unless otherwise indicated on the drawings or specified, no more than the conductors constituting a single circuit or branch shall be drawn in one conduit.

All wires and cables for power, lighting, control and telephone shall, as far as practicable in the judgment of the engineer, be continuous from origin to destination without running splices in intermediate pull boxes, splicing chambers or pull chambers. At the ends of these wires and cables only a sufficient slack shall be left as may be required for making proper connections. There shall be no unnecessary slack.

In connecting wires and cables to apparatus, various methods shall be used, depending upon the local conditions as detailed on the drawings. In general, solderless pressure connectors shall be used for terminals, taps and splices for all wires and cables except branch lighting circuits. Connectors generally shall be of the tapered sleeve type as manufactured by — and shall be sufficiently large to enclose all strands of the conductor. Connectors shall be securely fastened and shall not loosen under vibration or normal strain.

Where solid conductors are to be connected directly to the devices without the use of lugs, such as occurs at lighting switches and plug receptacles, the wires shall be formed into a loop to fit around the screws.

Where wires and cables are connected to metallic surfaces, the coated surfaces of the metal shall be polished before installing the mechanical connector. The lacquer coating of the conduits shall be removed where a ground clamp is to be installed.

All soldered joints shall be made mechanically strong before soldering and shall be carefully soldered without the use of acid, and taped with rubber tape to a thickness equal to that of the insulation and then with a covering of friction tape in two layers. The braid shall be cut back so that the insulating tape will bend with the insulation of the wire and cable.

The installation of wires and cables shall include the furnishing and installing of all hangers, racks, cable cleats and supports that may be necessary to make a neat and substantial wiring installation in all cable chambers, splicing chambers, cable pits and in such other locations as may be required. Marlin shall be used to hold the wires and cables together and to the racks or supports.

Each feeder cable in a pull box shall be tagged with the proper feeder symbol and where two or more feeders enter a panel or switchboard each cable shall be so tagged. Tags shall be 1-inch in diameter, of 1/16-inch brass, with stamped numbers and letters 1/4-inch high. Wires and cables of all branch circuits shall be identified by adhesive bands.

Aluminum Wire

Wire and cable shall be insulated aluminum EC grade, semi-annealed, of quality and physical characteristics particularly designed for installation in interior wiring systems, and approved for the purpose.

Insulation shall be — (R, RH, T etc.)

Aluminum conductors shall be of the number and size indicated on the (feeder schedule, riser diagram). Note. The National Electrical Code states "allowable current-carrying capacities shall be taken at 84% of those given in the table for the respective sizes of copper conductor with the same kind of insulation."

Splices and terminals shall be made expertly in an approved manner with approved connectors specially designed to be used with aluminum conductors.

Terminal ends shall be stripped carefully to avoid nicking the conductors.

Oxide inhibiting compound containing abrasive conducting particles in suspension shall be applied forcibly to the conductor and shall thoroughly penetrate spaces between strands.

a. Bolted connectors shall be approved and specially designed for use with aluminum conductor.

They shall be drawn up tight to the manufacturer's recommendations.

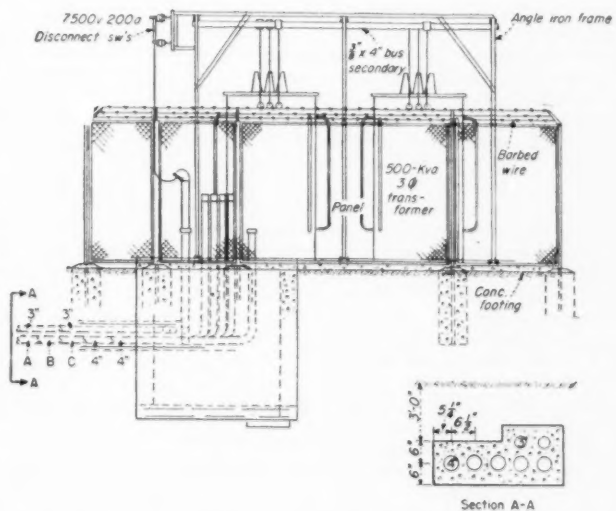
b. Connectors shall be of the high pressure type approved and specially designed for use with aluminum conductors. They shall be exact size and set up with tools designed to bring uniform pressure on all sides of the joint.

5.16 Bus Feeders

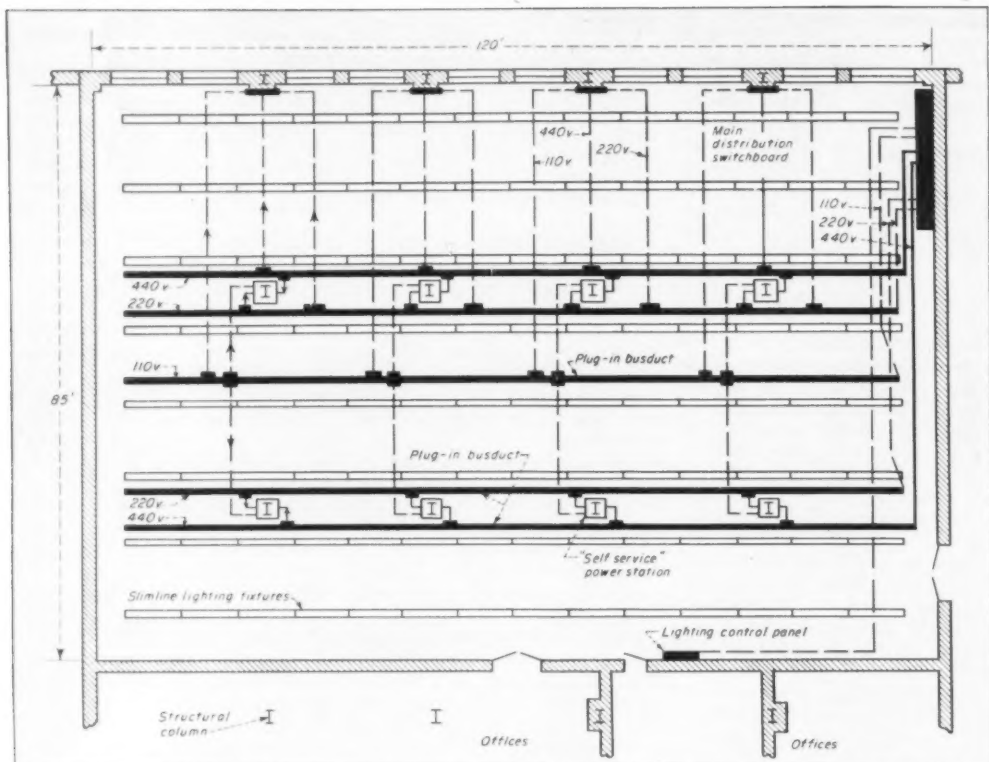
Bus duct is being used more and more extensively for distributing power from transformers to switchgear and then to motors, lighting systems and other electrical equipment. Composed of copper bars, suspended by insulators inside steel housings, it is made in several types and capacities, such as plug-in, low-impedance and weatherproof feeder units. It is fabricated, ready to use and easy to install, and provides flexibility and convenience, reliability and overload protection, and safety.

Provide a complete system of interconnected duct runs containing bus bars with plug-in current take-off devices spaced as indicated by single line drawing shown on plans and riser diagram.

Sections are to be made of standardized units, so formed that the complete assembly shall be rigid in construction and neat and symmetrical in appearance.



Underground distribution from outdoor substation to main switchgear inside industrial plant is via concrete-sheathed ducts.



Plug-in busduct may be used to carry power at 440-, 220- and 110-volts through a production area. All three voltages may be made available at each manufacturing position through branch circuits and busduct taps.

The duct sections shall be provided with standard hangers as indicated on the plans; however, rods or straps for connecting between the standard hangers or holes in the duct flanges and the building structure are to be fabricated and furnished on the job by the installer.

Interconnection of adjacent casing ends and bus bars shall be made by means of neatly fitted scarf lap joints and all joints or splices in bus bars shall be made with standard bolted connections.

Suitable handholes with covers are to be provided on both sides of each 10-foot section of duct along the bus runs permitting accessibility and ease of bus bar connection of adjacent duct sections.

Bus bars shall be fabricated from best grade 98% conductivity pure copper. All contact surfaces shall be silvered and shall have maximum contact areas and pressures.

Current take-off or plug-in openings shall be so designed as to insure proper polarization of the plugs in respect to bus bars and to prevent undue inductive heating. Not less than 10 plug-in openings shall be provided for each 10-foot section.

Current take-off devices or plugs shall be approved design, interchangeable for fuse, switch and fuse or circuit breaker type when desired. Plugs shall be of ample capacity to accommodate their respective circuits as shown on the riser diagram.

5.17 Cable Supports and Pull Boxes

Cable support boxes shall be installed in the riser shafts at the levels indicated. These boxes shall be built of steel, with removable cover secured by brass machine

screws and shall be stiffened with heavy angle irons.

Cable supports shall be of the double wedge type as manufactured by —, or as otherwise approved. Cable supports shall clamp each individual conductor firmly and tighten due to the weight of the cable.

Pull boxes, made of No. 12 U. S. gauge steel, shall be furnished and installed where indicated and wherever else such boxes may be necessary to facilitate the pulling or splicing of cables and wires. All such boxes must be made accessible and shall be constructed from approved detail working drawings. Conduits shall enter these boxes through tight-fitting clearance holes. Suitable supports shall be provided in all pull boxes to support feeders passing through the boxes so that feeder conductors will not remain unsupported for a distance greater than 3 feet. Each

feeder passing through the box shall be tagged or designated in some other approved manner. If tags are used, they shall be of fire-proof material.

Covers of boxes shall be designed for quick removal. When the system is finished, the boxes shall contain no openings except those carrying cables.

Wherever possible, steel barriers shall be furnished and installed between each group of feeder circuits. All pull boxes shall be securely fastened to the building structure by approved means.

Cable Trough

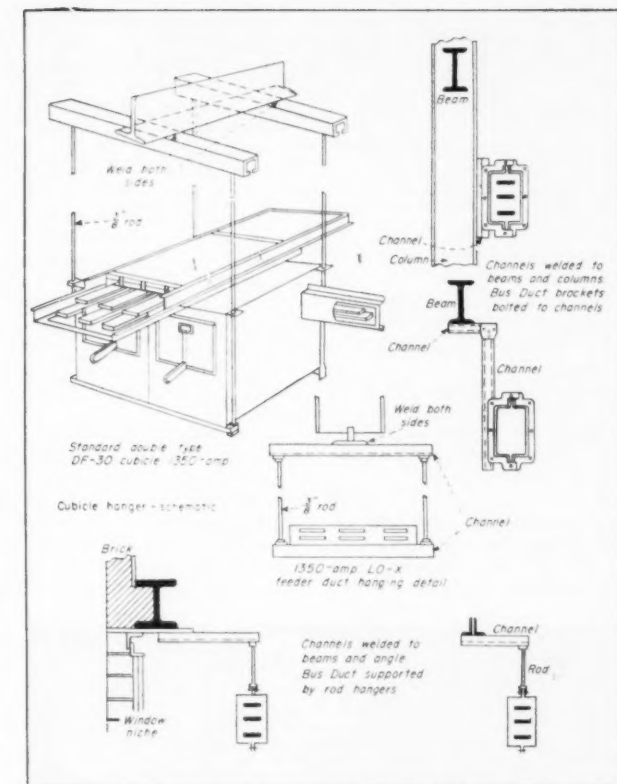
Where shown on the plans provide expanded metal cable troughs. The system of cable trough and fittings shall be standardized to permit easy assembly in the field. It shall be possible to change direction, elevation, and make branch taps through the use of standard fittings. Trough and fittings shall be of such construction as to permit the use of trough lengths which have been cut in the field. All trough and fittings shall be so designed and constructed that the finished trough system will not present any sharp edges or projections for contact with the cables.

Cable trough shall be made of flattened expanded metal, formed to a channel shape bent on a radius of not more than $\frac{1}{4}$ ". The standing sides shall be trimmed with a binding edge of No. 16 gage steel, spot welded at intervals to the mesh. The standard troughs shall be eight feet long. The trough and fitting widths shall be of standardized dimensions to permit future expansion using stock parts.

5.18 Underground Distribution

Feeders and circuits installed underground require special considerations based upon the type of installation, soil conditions, possibility of damage and local practice. Underground systems should be shown clearly on the plot plan. Runs should be direct and straight between manholes and terminal points, clear of roadways and separated from other underground systems particularly those requiring occasional maintenance or repairs.

All conduits run underground shall be installed in asbestos ce-



Busduct suspension methods include rod hangers, welded channels and busduct brackets. Connection of 600-amp ducts to 1350-amp feeders through double-end fusible cubicles.

ment (or steel, or fiber) conduits of the diameters and number of ducts specified or as indicated on the drawings.

Conduits shall be installed below the normal frost line; conduits containing high voltage cables (over 600 volts) being installed at least 30 inches below grade.

Trenches shall be graded so that the conduits will have a fall of at least 3 inches per 100 feet towards the lower manholes or from the high point of the section towards the manholes or from building towards manhole.

All conduits containing high voltage cables shall be enclosed in concrete not less than 3 inches beyond any surface of the conduit. Separators shall be used to secure a uniform spacing between conduits of not less than 2 inches. Concrete shall be 1-3-4 mixture.

The concrete envelope shall be reinforced at all points where con-

duits cross fill or loose soil, or water, gas or sewage mains. Reinforcement shall consist of one $\frac{3}{4}$ -inch reinforcing rod between each two ducts in bottom layer, and one rod laid at each lower corner of conduit envelope. Rods shall be laid parallel to conduits, centered between conduits and placed half way between bottom of conduit and bottom of concrete envelope. Reinforcing shall extend four feet beyond each end of fill or pipe main.

Fiber or asbestos cement conduits shall be mandrilled to insure a smooth interior wall free from burrs or obstructions that will damage the cable. A No. 8 B and A galvanized steel drag wire shall be installed and left in all spare conduits not containing cables. All conduits shall be equipped with end bells where these conduits terminate in walls of buildings or manholes.

6.1 Branch Circuits

6.12 Lighting Circuits

The minimum number of branch circuits required for general illumination should be based upon the standard loads.

For two-wire 15-amp circuits, the load per circuit should not exceed 1,000 watts.

For two-wire 15-amp circuits, the load should not exceed 1,000 watts between each outside wire of the circuit and the neutral wire.

For heavy-duty circuits, the maximum load per circuit depends upon the smallest size of wire used in the circuit and should be 1,500 watts for No. 10 and 3,000 watts for No. 8 or No. 6.

No wire smaller than No. 12 shall be used for any branch circuit. If the single distance from the panelboard to the first outlet

exceeds 50-ft. the minimum size of wire for this run shall be No. 10 and the minimum size between outlets shall be No. 12. Panelboards should be so located that no run from the panelboard to the first outlet will exceed 100-ft.; if in special cases this distance must be exceeded, the loads should be reduced or the wire sizes increased to provide for a voltage drop not exceeding 2% at the last outlet. This paragraph applies to both two-wire circuits and multi-wire circuits.

Show windows: Branch circuit wiring shall be installed to outlets for show window lighting, the circuit capacities to be based upon the wattage specified. If there is no specified load per outlet given, a load of not less than 200 watts for each linear foot of show win-

dow, measured horizontally along its base, should be used in determining circuit capacity. (N.E.C. Section 2116-C-2).

Case lighting: Branch circuit wiring shall be installed to outlets for show case and wall case lighting, the circuit capacities to be based upon the wattage specified and the actual or probable lengths to be lighted.

No convenience outlets shall be supplied by any two-wire circuit, or by any outside wire of a multi-wire circuit, that supplies one or more outlets for general illumination, show window outlets for general illumination, show window lighting or case lighting. Outlets for show window spot or flood-lighting and convenience outlets in or near the floor in show window spaces shall be controlled separately from the outlets for show window illumination called for.

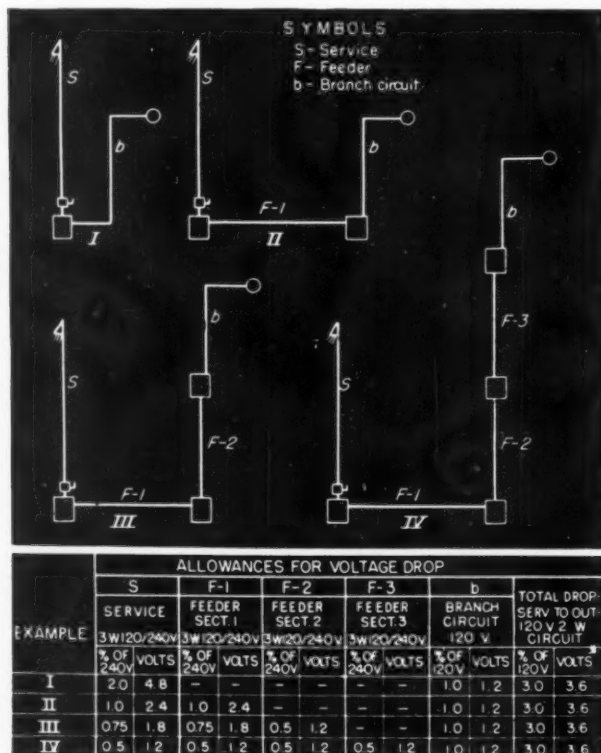
No wire smaller than No. 12 shall be used for any circuit supplying convenience outlets. Runs exceeding 100-feet in length from the panelboard to the first outlet should be avoided wherever practicable. If unavoidable, such runs shall be not smaller than No. 10 wire and the wire between outlets shall not be smaller than No. 12.

6.13 Power Circuits

Wiring for motors and heating apparatus shall be installed in accordance with the accompanying wiring diagram.

If no detail diagram is used the following may be included in the specifications.

a. Each motor shall be supplied by an individual branch circuit from a distribution center. Conductors shall not be smaller than the minimum sizes permitted by the National Electrical Code and shall be of such size that the voltage drop from the distribution center to the motor will in no case exceed 1% when the motor is carrying its rated full load. Feeder conductors shall be of at least such size that the voltage drop from the service equipment to any distribution center will not exceed 3% when all motors are operating at their rated full load.



Method of distributing the voltage drop loss over the electrical system from service entrance to utilization outlet.

On exceptionally long motor branch circuits, such as roof vent fans fed from basement panels, the voltage drop of the circuit on the starting current of the motor should not be greater than 10%. A better practice is to feed such motors from nearby panels and operate by remote control circuits.

b. Motors shall be supplied through group subfeeders from distribution centers. Subfeeders shall either be brought direct to motor starters (or disconnecting means) or shall be connected to starters (or disconnecting means) by means of tap conductors. Subfeeders shall be of at least such size that when all motors are operating at full load the voltage drop from the distribution center to any motor starter will not exceed 2%. Feeders from service equipment to distribution centers shall be of at least such size that when all motors are operating at full load the voltage drop from the service equipment to any distribution center will not exceed 3%.

c. Motors shall be supplied by individual taps from the bus bar distribution system. Taps or bus plugs shall be provided with (indicate whether disconnect switch, fuses, circuit breakers, etc.) as required. Circuit shall be extended from bus plug to controller in (conduit, flexible conduit, armored cable, heavy duty bus drop cable, etc.) not to exceed 25-feet in length. Circuit shall be installed so that conductors and terminal connections will not be damaged by machine vibration.

6.15 Methods of Wiring

State which of the following approved wiring methods shall be followed. Detailed installation requirements for each of these wiring methods will be found in the National Electrical Code.

Approved wiring methods commonly employed for new construction are:

- Rigid steel conduit
- Electrical metallic tubing
- Armored cable
- Non-metallic sheath cable
- Open and concealed porcelain protected (knob and tube)

Table of average circuit lengths for 3 and 4 wire balanced 115 v. lighting loads with 1% (1.15 volts) drop from supply cabinet to first outlet supplying permanently connected current consuming appliance or lighting fixture. All conductors grouped in same conduit.

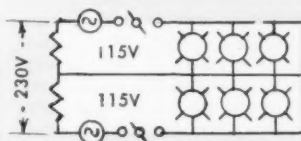
Copper resistance "R" — 13 ohms per CM ft. at 60°C (140°F)

AMPERES (A), WATTS (W), WITH CONDUIT CONDUCTOR (C), FILLS (F)

MAXIMUM OVERCURRENT CIRCUIT PROTECTION	INTERMITTENT LOADS			CONTINUOUS LOADS		
	100% F	80% F	70% F	100% F	80% F	70% F
	2-3 C	4-6 C	7-9 C	2-3 C	4-6 C	7-9 C
15 A	15 A 1725 W	12 A 1380 W	10.5 A 1207 W	12 A 1380 W	9.6 A 1104 W	8.4 Amps. 966 Watts
20 A	20 A 2300 W	16 A 1840 W	14 A 1610 W	16 A 1840 W	12.8 A 1472 W	11.2 A 1288 W
LOADS AND LENGTHS IN FEET FOR 1% DROP ON 3 AND 4 WIRE 115 V. CIRCUITS						
AMPERE LOAD		#10 WIRE	#12 WIRE	#14 WIRE		
1		946	596	374		
2		474	298	188		
3		316	198	124		
4		236	148	94		
5		190	120	76		
6		158	100	62		
7		136	86	54		
8		118	74	46		
9		106	66	42		
10		94	60	38		
11		86	54	34		
12		78	50	32		
13		72	46	28		
14		68	42	26		
15		64	40	24		
16		60	38			
17		56	36			
18		52	34			
19		50	32			
20		48	30			
21		46				
22		44				
23		42				
24		40				
25		38				
26		36				
27		36				
28		34				
29		32				
30		32				

On 4-wire, 3-phase "Y" power and light service with 2-ph, 3-wire circuits use $\frac{1}{2}$ table circuit lengths for 2-ph circuits when tapped off 4-wire system.

For 2-wire, 115-volt circuits, use one-half table circuit lengths.



Example: 2-Wire, 115-volt, No. 14 wire circuit

$$\begin{aligned} \text{Length} &= 1.15 (\text{Volt drop}) \times 4102 (\text{CM of } \#14\text{W}) \\ &= 15 (\text{Amps.}) \times 2 \times 13 (\text{R of wire @ } 60^\circ\text{C}) \\ &= 12.1 \text{ feet} \end{aligned}$$

- f. Busways
- g. Wireways
- h. Underfloor duct
- i. Cellular metal floors

Branch circuits shall be installed as shown on the floor plans. No wire smaller than No. 12 shall be used for any branch circuit unless otherwise noted on plans for special system circuits. Larger sizes shall be used where required and indicated on the plans.

Outlets shall be located approximately as shown on the plans and shall be properly centered where located in panelled work or other special interior finish.

Wall switch outlets shall be installed as shown on the plans and shall be wired to provide control of outlets indicated.

The conductors terminating at each wired outlet shall be left not less than 8-inches long at their outlet fitting, to facilitate the installation of devices or fixtures. Where two or more pairs of conductors or circuits enter an outlet, the several pairs or circuits shall be neatly spliced and made mechanically and electrically secure to one or more single or multiple conductors, which conductors shall be not less than 8-inches long within the outlet.

Specify the type of wiring systems to be employed, the raceways, and conductors and outlet boxes, indicating the quality, and any special feature of finish or grade. Choice of wiring systems is often limited in application by local ordinances and rules.

One example of the careful consideration which must be given to conduit design is the special wiring required to supply tenants in office buildings using metered electric current. Wiring for this purpose must be so designed that groups of circuits are available for tenants use through one meter irrespective of the number of rooms occupied by that specific tenant.

The use of wall receptacle outlets properly placed as conduit junction boxes offers a good solution to this problem. It is important that these receptacle outlets be so placed that they will not be concealed by either present or future room partitions. These receptacle junction boxes are tied together by $\frac{3}{4}$ -inch conduit runs and can be used for extensions to both present or future room outlets. For such use, boxes should be the $4\frac{1}{2}$ -in. square type with plaster cover.

6.21 Conduit

For all conduit work as called for elsewhere in these specifications or shown on the plans, furnish and install (select one or more types and state where each type shall be used):

- a. Galvanized rigid steel conduit,
- b. Corrosion resistive, non-ferrous rigid conduit.
- c. Flexible metallic conduit.

All conduit, elbows and couplings shall be as manufactured by — or equal.

6.22 EMT

For all electrical metallic tubing work as called for elsewhere in these specifications or shown on the plans, furnish and install approved tubing as manufactured by — or equal.

6.23 Armored Cable

For all armored cable wiring as called for elsewhere in these specifications or shown on plans, furnish and install approved armored cable, properly bushed at ends and securely fastened to outlet boxes with approved connectors. Armored cable shall be of the best quality designed to offer a low resistance grounding path. Armored cable shall be as manufactured by — or equal.

6.24 Non-Metallic Sheath

For all non-metallic sheathed cable wiring as called for elsewhere in these specifications furnish and install approved non-metallic sheath cable of the — type as manufactured by — or equal.

6.25 Open Wiring

For all open wiring or knob-and-tube work called for elsewhere in these specifications, furnish and install non-combustible, non-absorptive insulating bushings, cleats, knobs and tubes as manufactured by — or equal, and flexible non-metallic tubing as manufactured by — or equal.

6.31 Branch Circuit Conduits

Conduits shall be of sizes required to accommodate the num-

ber of conductors in accordance with the tables given in the current edition of National Electrical Code or as noted on drawings. The minimum size of conduit shall be — inch. Joints shall be cut square, reamed smooth and drawn up tight.

Concealed conduits shall be run in as direct a line and with as long bends as possible. Exposed conduits shall be run parallel to or at right angles with the lines of the building. All bends shall be made with standard conduit ells, conduit bent to not less than the same radius or screw jointed conduit fittings. All bends shall be free from dents or flattening. Not more than the equivalent of four quarter bends shall be used in any run between terminals at cabinets, outlets, and junction or pull boxes. Boxes shall be located in accessible locations.

Conduits shall be continuous from outlet to outlet, and from outlets to cabinets, junction or pull boxes, and shall enter and be secured to all boxes in such a manner that each system shall be electrically continuous from point of service to all outlets. Terminals of all conduits shall be furnished with locknuts and bushings. Plug the ends of each conduit with an approved cap or disc to prevent the entrance of foreign materials when exposed during construction.

All terminals of electrical metallic tubing shall be provided with approved watertight fittings.

So far as practicable, all exposed conduits shall be run without traps. Where dips are unavoidable a pull box shall be placed at each low point or a hole drilled in underside of conduit to provide means of escape for any moisture which may tend to collect in the conduit. Conduit systems shall be completed before conductors are drawn in. Where conduits must be run exposed, except as indicated in the plans, locations of the runs shall be subject to approval.

All conduit and electrical metallic tubing shall be securely supported by — straps or supporting assemblies as indicated on the plans.

Considerations: On concealed conduit jobs exposed runs are usually installed where concealing would weaken structural features, slabs are too thin

for the size of conduit required or in unfinished spaces.

6.32 Outlet Boxes

Boxes for ceiling and interior bracket lighting fixtures shall have fixture studs. All studs shall be in centers of boxes and shall be strongly secured.

Boxes shall have only the holes necessary to accommodate the conduits at point of installation. All boxes shall have lugs or ears to secure covers.

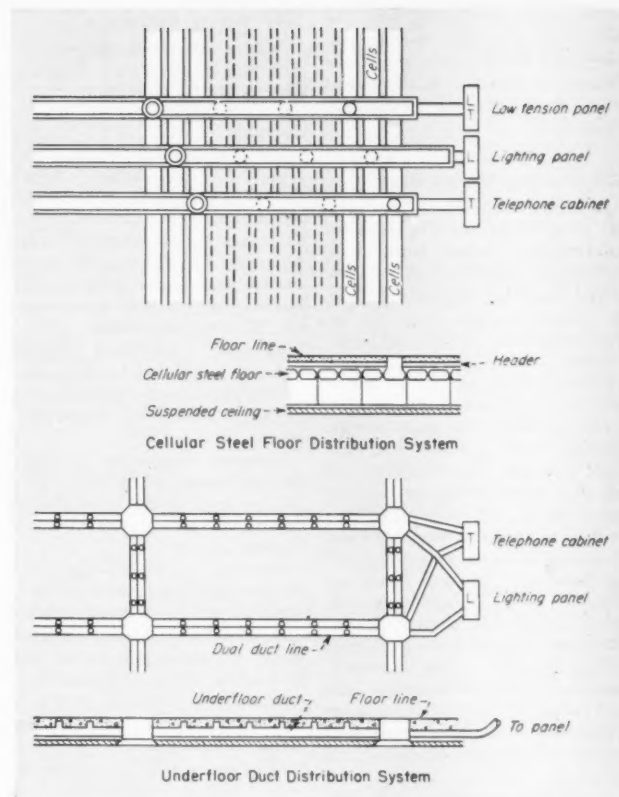
Ceiling outlet boxes where conduit is concealed shall be not less than 4-inches in diameter by 1½-inches deep with plaster covers. Outlet boxes where conduit is exposed shall be screw jointed and not less than 6-inches in diameter to provide a seat for fixture canopy. Where surface metal raceway is used, outlets shall be of sufficient diameter to provide a seat for fixture canopy.

Outlet boxes for wall fixtures where conduit is concealed shall be deep type, 4-inches in diameter, and have covers with center opening 3-inches in diameter. Outlet boxes for bracket fixtures where conduit is exposed shall be screw jointed and not less than 6-inches in diameter to provide a seat for fixture canopy.

Standard deep type concrete outlet boxes, shall be used where conduits enter sides in order to avoid steel reinforcing rods.

Outlet boxes for switches and plug receptacles in finished walls shall be of one piece standard gang boxes, 4-inches by 4-inches by 1½-inches deep for 1 device, 6⅞-inches by 4-inches by 1½-inches deep for 2 devices. They shall have covers with rectangular openings of proper size and shape. Outlet boxes for switches and plug receptacles on unfinished walls where same cannot be concealed shall be set exposed, unless otherwise noted on plans, and where exposed shall be screw jointed with covers to fit the device.

All boxes shall be rigidly secured in position. All boxes, except on unfinished ceilings and walls, except outlets for extensions, and except where conduit is run exposed shall be so set that the front edge of box shall be flush with finished wall or ceiling line or not



Two typical methods of underfloor branch circuit distribution are the cellular steel floor method (top) and underfloor duct (bottom) for conventional concrete floor construction.

more than one-fourth inch back of same. Bracket outlets shall be set 5-feet 6-inches from floor. When located on columns or over doors they shall be set symmetrical with columns or door.

Wall switch outlets 4-feet 6-inches above floor shall be set flush in walls. When located near doors or windows they shall be close to trim. Plug receptacles shall be 12-inches above finished floor unless otherwise noted and set flush in walls.

Wall switch outlets shown at door locations shall be installed on the lock side of the door.

Outlet boxes for telephone, signal, pushbutton and buzzer outlets shall be about 4-inches square and shall have covers with rectangular opening in center. Each such outlet shall have a plate with ⅜-inch bushed opening in center.

Telephone wall outlets shall be

set flush in wall 12-inches above finished floor unless otherwise noted. Signal outlets shall be flush in wall 12-inches above floor or near ceiling, as indicated by symbol or noted on drawing.

Outlets for clocks over doors shall be set so that when clock is installed same will center between top of door trim and ceiling. When there is no door they shall be set about 7-feet above the floor. These dimensions may be varied if desired to suit architectural conditions. Outlets shall have boxes, covers, single-plug receptacles and wall plates similar to those elsewhere specified for duplex receptacles except that receptacle shall be recessed so that when plug is inserted it will be flush and allow clock to hang covering outlet. Suitable hook shall be provided to support clock. Where the clocks are installed under the same contract

as the electrical system, and the voltage for the clock wiring does not exceed 50-volts, or where clocks operate on three wires, the receptacles at clock outlets may be omitted.

6.33 Junction or Pull Boxes

Junction or pull boxes not over 100 cubic inches in size shall be standard outlet boxes. Junction or pull boxes over 150 cubic inches in size shall be constructed same as cabinets, covers may be of same thickness as boxes and be secured by screws or bolts. All junction boxes shall be coated inside and out to prevent oxidation.

Junction boxes in main service conduits shall be ample size. All other junction boxes shall be not less than 4-inches square by 1½-inches deep. All junction boxes shall have closed covers and must be accessible after completion of the building. Junction boxes on concealed conduits shall be set with covers flush with finished plaster line, and on exposed conduits shall be set exposed, unless otherwise noted on drawings. Junction and pull boxes of sizes proportionate to the sizes of conduits or conductors served shall be installed where shown on drawings, and where necessary or convenient for installing the wires.

Floor boxes shall be of the watertight, adjustable type, arranged so that the top may be varied from the plane of its base. The boxes shall be approximately four inches in diameter by three and one-half inches deep. Each box shall be provided with a plug outlet or knockout as required. A gasket in a groove or an approved sealing cement shall be supplied between adjusting ring and body to make the box watertight.

Cover plates shall be of heavy brass with permanent ring or flange and rubber gasket. Brass cover plate shall have threaded hole approximately 1¼-inches in diameter, closed with flat plug in center. Covers shall be flush with the finished floor. For power outlets a receptacle shall be installed. All boxes shall be furnished with an outlet nozzle with bushed outlet, and threaded to fit hole in cover plate or other approved floor stand.

6.41 Wiring Devices

Where shown on the plans furnish and install wiring devices indicated by the symbols.

Switches

Flush switches shall be tumbler type, "T" rated, unless otherwise noted on the plans. Switch mechanism shall be completely enclosed in stable composition or ceramic housing. Terminal screws or connectors shall be designed to accommodate and firmly terminate up to No. 10 solid conductors.

Switches controlling 125-volt lighting or heating loads in excess of 500 watts up to 1500 watts shall be rated at not less than 20-amperes.

Switches controlling or disconnecting motor loads in excess of 1/3 hp shall be hp rated and approved for motor control or disconnect service.

Switches shall be single pole, double pole, 3-way or 4-way as indicated by the symbol. Where tumbler switches operate vertically, single or double pole switch shall be "on" in the upper position. If operated horizontally single or double pole switches shall be "on" in the left position.

Switches indicated by the appropriate symbol shall be lock type, key operated.

Where more than one switch is shown at one outlet, they shall be installed under one plate in an order appropriate to the location of the outlets controlled.

Mercury Switches

Switches shall be of the sealed mercury button type designed for installation in standard switch boxes. They shall be flush tumbler type mounted vertically and single pole types shall have "on" and "off" positions indicated on the handle.

Plug Receptacles

a. Plug receptacles, unless indicated as special purpose, shall be flush type 15-ampere, 120-volts, duplex grounding type. Receptacles shall be designed to accept standard 2-wire parallel blade connector caps or 3-wire grounding connector caps.

b. Plug receptacles, unless indicated as special purpose, shall be flush type 15-ampere, 120-volts tri-

plex. Receptacles shall be designed to accept standard 2-wire parallel blade connector caps.

c. Plug receptacle, unless indicated as special purpose, shall be flush type 15-ampere, 120-volts, duplex type with T slots. Receptacles shall be designed to accept either 2-wire parallel blade or 2-wire tandem blade connector caps.

Receptacles shall be designed to grip both sides of the connector blades.

Terminal screws or connectors shall be designed to accommodate and firmly terminate up to No. 10 solid conductors.

Combination fan hanger and receptacle: Provide a receptacle and hanger of suitable strength to support a 16-inch oscillating fan at all fan wall outlets. The receptacle shall be of standard type (single) and the hanger shall be secured to the outlet box by supports independent of the face plate or box cover. Outlet box shall be securely fastened in place. In all cases where conduit runs do not extend vertically through fan outlet provide a conduit nipple at least 12-inches long built into wall construction vertically and opposite the circuit conduit. Unless otherwise noted, fan outlets shall be 6-feet 10-inches from floor and shall be set to clear window trims or other obstructions by at least 12-inches.

Clock Receptacles

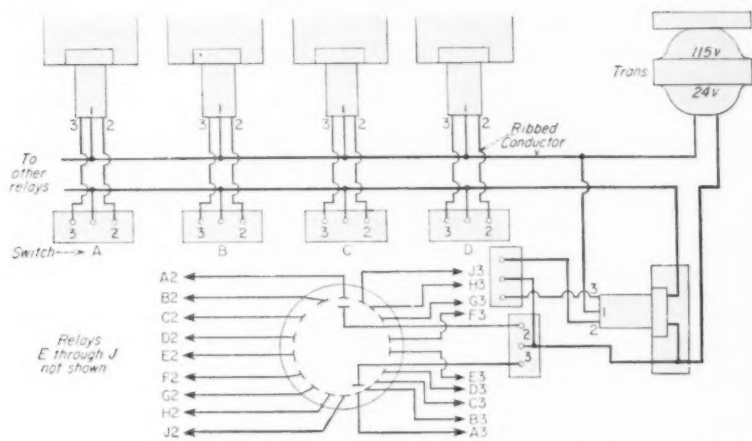
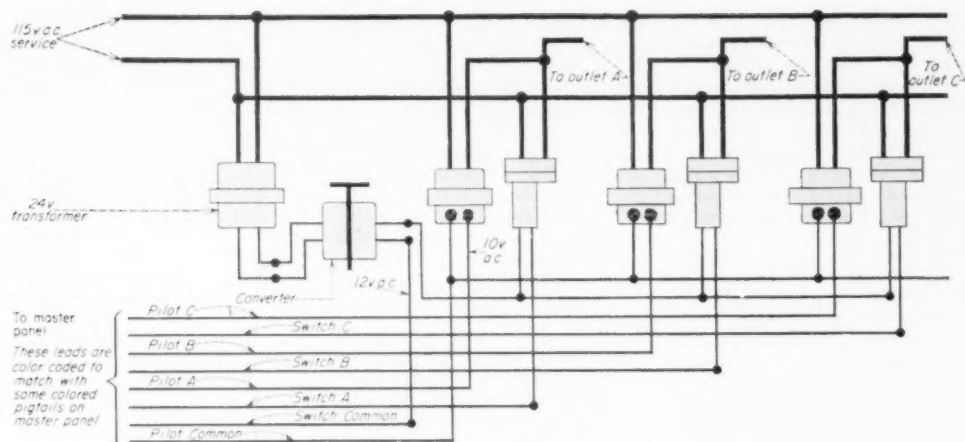
Where indicated furnish and install receptacles and plates for the attachment of individual synchronous electric clocks. Receptacles shall be single, and recessed below the surface of the plate to permit the clock to rest against the plate with the plug in place.

Special Purpose Receptacles

Special purpose receptacles shall be flush type of the capacity and design indicated or required for the equipment or appliance connected. They shall be designed to receive connector caps of appropriate rating and polarity only.

Plates

Furnish and install wall plates for all wiring devices, signal and telephone outlets. Plates shall be (composition, brass, etc.) of — thickness. (add color, finish, special markings as required.)



Two systems of relay switching control. Two-wire system is at top. Three-wire system is at bottom.

HOOKUP DETAIL of two wire (Touchplate) control units. Relays position on and off in sequence from momentary contact switches. Small transformers energized from the relay switch leg send low voltage back to pilots at master switch panel.

HOOKUP DETAIL of 3-wire (G. E.) Remote Control. Relays position on and off by three wire momentary contact switches. Master control is a rotary selector switch. Relays are usually mounted at outlets but they may be ganged in a central location.

When devices are installed in exposed fittings or boxes the plates or covers shall be of a type designed to fit the fitting or outlet box.

Locking Receptacles

Plug receptacles where indicated by symbol shall be of the locking type. Locking receptacles shall be — pole 15-ampere 120-volt rating unless otherwise indicated and shall be so designed that a cord, when connected by means of the matching connector cap, cannot be pulled from the receptacle until the locking feature is disengaged.

Heavy Duty Receptacles

Receptacles for heavy duty industrial service, special voltages, hazardous

areas and other special uses and environments are available for a variety of portable connector applications. Such receptacles are usually described in specifications by reference to the particular catalog numbers of one or more manufacturers.

6.45 Low Voltage Switches

Low voltage relay switching provides switching control similar in operation to the remote control of motors on industrial machines. Circuit switching is performed by relay switches. The relay coils are operated by momentary contact devices from a low voltage supply. Paragraphs marked "a" are for sequence systems, paragraphs "b" or "c" for positioning systems.

Outlets and circuits indicated by the appropriate symbol on the

plans are controlled by a remote control low voltage relay system.

Furnish at each outlet where indicated a relay switch installed in a box knockout and connected in an approved manner, or

Furnish and install at each location where indicated a remote control relay switch cabinet complete with the number of relays shown. The relays shall be installed in barriers which effectively isolate the circuit conductors from the low voltage control wiring.

Switches indicated by the appropriate symbol are low voltage remote control type.

Furnish and install at each switch outlet one or more, as indicated, momentary contact low voltage switches of an approved

type designed specifically for low voltage remote control switching service.

a. Switches shall be 2-wire single pole, normally open, to operate sequence on-off relays.

b. Switches shall be 3-wire single pole two position normally open, to operate relays with separate solenoids for on and off positions.

Master Switch

a. At master switch location furnish and install a multiple switch assembly for master switch service. Each switch shall operate the outlet or circuits indicated and shall be wired to parallel the local switch. Pilot lights associated with each button shall indicate when the relay is in "on" position.

b. At master switch locations shown furnish and install a combination switch and selector. Manual rotation of the selector shall connect the switch to operate each of the outlets or circuits controlled. The appropriate selector terminals shall be wired to parallel the local switch.

c. Switches shown as master switches shall operate a remotely-controlled electrically-operated master selector switch. When pressed in the "on" position, the switch shall cause the selector to sweep the "on" contacts of the outlets and circuits controlled. When pressed in the "off" position, the switch shall cause the selector to sweep the "off" contacts. Selector terminals shall be wired to parallel the local switch of each outlet or circuit controlled.

Pilot Lights (low voltage)

Furnish and install where shown low voltage pilot lights of a type specifically designed to operate with the low voltage, remote control switching system.

a. Current for operating each pilot light shall be obtained from an associated current-limiting transformer installed in the relay cabinet. The primary shall be connected to the controlled circuit; the secondary shall be wired to the pilot light.

Power Supply (low voltage)

Low voltage power for relay operation shall be provided from transformers specially designed for the service and for the system installed. Transformer characteris-

tics and installation shall conform with the requirements of Article 725 — Remote Control, Low Energy Power and Signal Circuits, National Electrical Code.

a. (dc operation) The power supply for relay operation shall include converters or rectifiers to provide dc operating current to the relays. Rectifiers shall be of a type specially designed for the service and the system and shall be enclosed within the relay cabinet.

Wiring

Conduit, raceways, junction boxes and outlet boxes for the low voltage control circuits shall conform with the specifications for Signal and Communications System.

Wiring shall be done with wires and cables of the size and type designed for the system or recommended by the manufacturer. Multi-conductor cables shall contain identified conductors, and circuits shall be wired to maintain a consistent and uniform identification scheme.

6.51 Busways and Raceways

Furnish and install a complete enclosed bus bar distribution system as shown on the plans. Busway shall be — volt, — phase, — pole, of the ampere capacities as indicated (specify the ampere size of bus way for various sections of the branch circuit distribution system). Each 10-ft. section of busway shall have 10 covered openings for attachment of plug-in type current take-off devices. The system shall be complete with all fittings, enclosures, insulating and supporting members as shown; shall be

supported from the building structure at 5-foot intervals. System and parts shall be of the same manufacture and designed to be used together. Assembly and installation shall be made according to the manufacturer's recommendations. The system shall be as manufactured by — Company or equal.

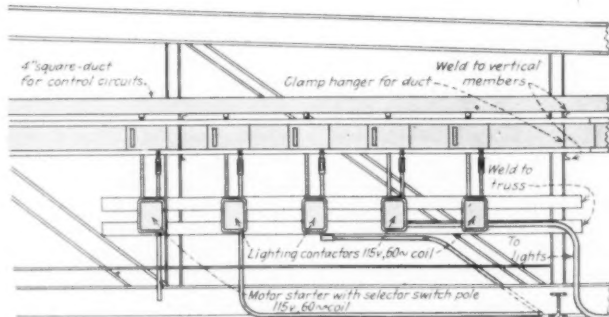
Installation should be detailed on the plans and all bus capacities, taps and fittings noted. Specifications may include gauge of metal, dimensions of copper bars, type of insulation, facilities for tap connections and methods of attachment to building structure. Unless the busway system is made up of standard lengths and fittings, a manufacturer's detailed dimensional drawing for the complete system should be secured and approved before the equipment is installed. It is not advisable to cut busway sections to fit structural requirements at field locations.

Furnish and install bus plugs as listed and at the locations shown on the plans. Bus plugs shall be of the type and size designated and shall be of the same manufacture as the busway and designed for use with it. (Specify disconnect, over-current protection, capacity and type of raceway or cable connection required.)

Connections from the plug-in device to the equipment shall be made with (Specify wire and conduit, flexible metallic conduit, or heavy duty, multi-conductor, bus drop cable).

When busways are used on ungrounded systems, a potentializer plug should be installed to establish a definite potential to ground.

When used as branch circuits, busways should be limited to such lengths



Plug-in bus duct and square duct raceway serve lighting and motor circuits in an industrial plant. Detailed drawings such as this should be included in plans.

as will provide that in normal use the circuits will not be overloaded. In general, the length of such run in feet should not exceed three times the ampere rating of the branch circuit (195 N.E.C., Section 3652).

6.52 Busways with Movable Contacts

Furnish and install a complete busway system as indicated and detailed on the plans for operation mobile devices. Busways shall be — ampere, — phase, — pole, — volt. System shall be complete with necessary hangers, devices for inserting current collecting units, cable feed-in facilities, end closures and bumpers. All parts shall be of the same manufacture and designed to be used together. Assembly and installation shall be made according to the manufacturer's recommendations. System shall be as manufactured by — Company or equal.

Furnish and install the current collecting units as listed and shown on the plans. Units shall be designed for use with the busway and provide continuous contact with the buses and move freely in the busway.

Mobile busway system should be detailed on the plans with full and accurate dimensional information. Methods of supporting the installation and circuiting to the various busway sections should be clearly indicated.

6.61 Multi-Outlet Assemblies

At locations shown on plans furnish and install a multi-outlet assembly in one or more continuous sections. These sections shall consist of an assembly having outlets to receive standard attachment plugs spaced — in. apart. They shall be as manufactured by — Company or equal.

For window and cove lighting reflectors furnish and install assemblies of metal raceway or wireway containing lamp receptacles connected on circuits as indicated on wiring plans. They shall be as manufactured by — Company or equal.

Cellular Steel Floor

Building construction in the areas shown consists of cellular steel floor of a type approved for use as raceways for conductors.

CELLULAR STEEL FLOOR CIRCUITS
ALLOWABLE NUMBER OF WIRES IN
STANDARD HEADER DUCT

Size Awg	No. of Wires in 40 Per Cent of Header Duct	
	Types R RH, RW	Types T, TW, RT
14	109	185
12	90	145
10	54	112
8	33	61
6	20	31
4	16	23
3	14	20
2	12	17
1	9	12
0	8	11

In these areas, wiring distribution for the 110-volt branch circuits, branch telephone circuits, and low tension (any other) systems, shall be installed in the floor cells, as noted on the plans.

Furnish and install all header ducts, end closures, feed connections, floor covering adapters, outlets and taps as listed and shown on the plans. All devices shall be as approved by the Underwriters' Laboratories for use with cellular steel floor systems and as supplied by the — Company.

Cover plates, furnished by others, shall be brushed with cold flowing compound and attached to the floor by self-tapping screws.

End closures shall be thoroughly sealed with tape and compounds as recommended by the manufacturers.

All fittings and outlets shall be installed in an approved manner according to the practices recommended by the manufacturer.

The cellular steel floor shall be grounded at a suitable location in accordance with local regulations.

The headers, outlets, extensions from cells, etc., shall be roughed-in as a system and all wire shall be pulled after fill and finish are completed.

Install suitable markers, identifying particular cells of each system, on top of selected cells and finish flush at screed line. Extend marker through floor covering with a grommeted screw. There shall be one marker per system for every 200 square feet of floor area, and not less than two per system per room, as directed.

A total of — floor taps and 110-volt (specify type) outlets shall be cut in where directed upon occu-

pancy. These shall be wired complete, with a maximum of — outlets per circuit. Furnish — outlets, complete with taps, as spares.

A total of — floor taps and (specify type) low-tension floor outlets shall be cut in where directed upon occupancy. Furnish — outlets, complete with taps, as spares.

For specific regulations concerning the use of cellular steel floor cells as raceways for electrical conductors, see Article 356 of the current edition of the National Electrical Code.

Surface Raceways

Furnish and install where indicated on plans surface metal raceways as made by — Company or equal. Raceway, elbows, fittings and outlets shall be of the same manufacture and designed for use together. They shall be of a size approved for the number and size of wires installed. They shall be installed in an approved and workmanlike manner. Runs shall be parallel or at right angles to walls and partitions. Connections shall be made to other types of raceways in an approved manner with fittings manufactured for the purpose and application.

The number of conductors installed in any raceway shall not be greater than the number for which the raceway is approved. In no case shall more than 10 conductors be installed in a single raceway compartment.

If combination metal raceways are used for both signal, lighting and power circuits, the different systems shall be run in separate compartments, identified by sharply contrasting colors of the interior finish, and the same relative position of compartments shall be maintained throughout the premises (Article 352, N.E.C.).

Underfloor Systems

Furnish and install a complete (metal) (fiber) underfloor duct system as shown on the plans. System shall consist of (number) ducts, as indicated, to provide raceways for (110-volt) (telephone) (low tension) system wiring. All duct, fittings, junction boxes, outlets, connectors, and supporting brackets shall be as manufactured by the — Company, or equal and designed for use with this system.

Duct, junction boxes, outlets, and connections shall be installed according to manufacturer's recom-

mendations and with the best workmanship. All surface covers, where intended to be flush with the finished floor, shall be level and true. All inserts shall be sealed against entrance of moisture. Dead ends of all ducts shall be closed and sealed.

Unless otherwise indicated, all outlets for all systems shall be installed and wired complete.

Suitable markers shall be installed at the end of every line of raceway to mark the line of the duct. Suitable markers shall be installed to act as base points for locating duct outlets for future use.

Regulations covering underfloor raceway installations are given in Article 351 of the National Electrical Code.

Metal Framing as a Raceway

Local electrical inspection authorities in a number of cities and localities throughout the country are permitting the use of a steel channel, all-bolted framing member as a combination rigid electrical fixture support and lighting branch circuit conductor raceway under a special permission arrangement. Such permission is contingent upon the channel opening between fixtures being equipped with snap-in closure strip.

This cold-rolled steel channel with a continuous slot comes in a square and rectangular cross section; has a serrated nut and bolt assembly which can be inserted and tightened anywhere along the length of the slot; was originally marketed as a framing member. The adaptability of the channel has resulted in its use for supporting fluorescent lighting fixtures in continuous row, end-to-end, and alternate spacing patterns. The logical use of the empty space inside the channel as a raceway for the fixture branch circuit conductors followed.

Before specifying this type of channel as a combination fixture support and conductor raceway, secure written approval of its use as such from the inspection authorities having jurisdiction in the area in which the installation is to be made.

6.71 Hazardous Locations

Design of electrical installations is exceptionally critical in hazardous areas where there is the slightest possibility of an explosion or fire result-

ing from an electric spark. Types of equipment and methods of wiring and installation are strictly controlled and limited by specific regulations in Article 500 of the current issue of the National Electrical Code.

When designing and installing electrical systems in this type of area, carefully check the class of hazard against the equipment listing, secure the owner's statement as to the type of operation to be carried on within the area, and check the design and proposed layout with the local inspection authorities. After determining definitely the degree of hazard and NEC classification, follow carefully the Code regulations governing installations in that type of area.

Extreme care should be exercised in handling and installing equipment in hazardous locations. It should be stored away from dust and dirt. Fitting and enclosure covers should not be removed before installation; machined and threaded surfaces should not be marred. All threads should be carefully aligned before cover or bolt is tightened. All conduit and box connection threads should be made up tight with at least five threads engaged.

Typical Specification

All equipment, fittings and wiring installed in the — area shall be as approved by the N.E.C. for Class — Division — locations. Materials shall be of the best quality designed and approved for the type of hazard listed. Installation shall be made by mechanics thoroughly experienced in this type of work and workmanship shall be of the best quality and skill to assure maximum safety. Sealing fittings shall be properly installed at all required locations in accordance with Code regulations.

Fittings shall be as manufactured by the — Company or equal.

Switches and controls, as listed, shall be as manufactured by the — Company or equal.

Lighting fixtures, as listed, shall be as manufactured by the — Company or equal.

6.81 Emergency Lighting Systems

Emergency lighting systems are required by state laws, municipal ordinances, and by the National Electrical Code. While these requirements ap-

ply generally to theatres, moving picture houses, and other public gathering places, some states and cities have regulations which stipulate additional occupancies for which emergency lights must be provided, such as hotels, schools, factories, etc. Current supply for emergency lighting may be provided by one of the following methods:

- A. Two or more independent sources of supply.
- B. Auxiliary standby current in conjunction with normal service:
 1. Automatically charged batteries.
 2. Automatically started generators.
 3. Small non-compulsory emergency battery systems.
- C. Connection on supply side of main service if sufficiently separated from main service.

Emergency lights must be lighted during definite periods of occupancy or building use. In case of failure in the normal current supply, they must be automatically transferred without appreciable delay to an emergency source of current. The emergency lighting system must be capable of lighting, for a specified period of normal current supply failure, all exit signs, and also provide sufficient illumination to enable persons to leave a building safely.

In many local or state regulations, the number, location and wattages of lighting outlets are prescribed, also the types and the ampere-hour or full-load capacity of auxiliary emergency systems are set forth, stating the minimum voltages that may be applied to standard lamps.

Specifications for equipment and wiring layouts for emergency lighting systems should therefore be checked in detail with the inspection authorities having jurisdiction.

Independent Sources

Where two or more separate and complete systems with independent current supply can be installed, each of the systems may supply a part of the emergency lighting provided all emergency lights supplied on each independent current supply system are lighted. The several supply systems may also serve all or a part of the general lighting system.

Unless all the emergency lights served by two or more independent supply systems are kept lighted, a throw-over switch must be provided which will

automatically transfer the emergency service in case of current failure.

Auxiliary Current Supply

Auxiliary generators (System B-2) with prime movers may be used in lieu of storage batteries (System B-1), provided they are equipped with automatic controllers, and are capable of generating the energy required for the full emergency load within a certain reasonable time limit after a current failure occurs.

a. Prime movers for driving auxiliary generators must be automatically started and may be:

- a-1. internal combustion engines,
- a-2. steam driven engines,
- a-3. steam or water driven turbines.

b. Automatic controllers must include approved storage batteries of the correct capacity for necessary cranking of the foregoing types of engines, or for operating the engine supply valves, as the case may be. When cranking batteries are employed, approved automatic charging devices must be provided for them. These generators commonly operate at 110- to 115 volts.

c. Automatic throw-over switches, as called for in System A must also be provided for Systems B-1 and B-2 to connect the emergency lighting circuits to the standby auxiliary equipment.

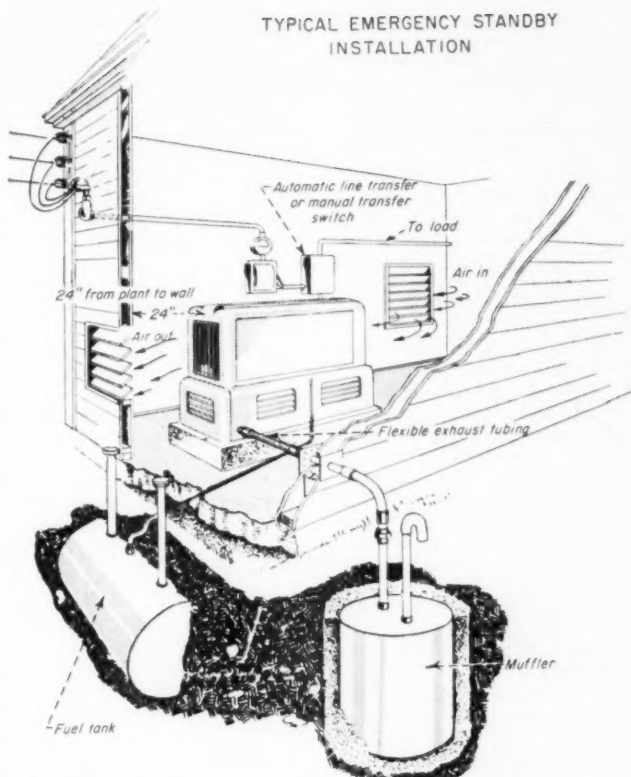
d. Auxiliary generators are sometimes permitted to be installed with sufficient capacity to supply all or part of the general lighting system, as well as the emergency lighting outlets prescribed by regulations.

Warning Signals

Approved warning or derangement signal devices of the audible or visual types must be provided for systems B-1 and B-2. These signals shall automatically give warning of a derangement of the emergency current sources, and shall indicate when batteries or a generator set are carrying the emergency illumination load.

Small Systems

Small emergency lighting systems (B-3) are used voluntarily in banks, stores, factories and other places that are not required to provide emergency lighting systems. These systems are designed to supply through a storage battery a small number of specially equipped lighting units located in several important areas. A separate cir-



Typical installation of an emergency standby unit with automatic transfer and control.

cuit is run from an automatic battery control panel to these lighting units. This circuit has no electrical connection with other normally supplied circuits. The automatic control panel usually consists of an automatic battery charging device and an automatic switch or relay for turning on the auxiliary lighting circuit whenever there is a failure in normal energy supply. A power supply connection must be provided between the control panel and the normal supply system for the throwover relay and for the automatic battery charger. These systems usually operate at from 10 to 32 volts. Wiring must be designed for low voltage loss.

Typical Specification

Furnish and install a complete emergency lighting system, as shown on the plans, including all feeders, branch circuits, emergency lighting panels. All wiring shall be in accordance with provisions

of the National Electrical Code and all local regulations covering this type of installation.

The emergency standby generator set shall be rated at — kw, — volts, — phase, 60 cycle. It shall consist of a — engine directly connected to a single-bearing, four-pole generator, and equipment to automatically start the set upon power failure of normal source and transfer the load to the generator.

The generator shall be of saturated field, four-pole, revolving armature design directly connected to the engine flywheel by means of a semi-flexible steel driving flange to insure permanent alignment. It shall be rated at — volts, — phase, — cycle, —kw, continuous output with inherent voltage regulation within 10% from no load to full load. The engine shall be cranked through the exciter of the generator through special 12-

volt cranking winding with current obtained from two 6-volt batteries. Batteries shall be recharged from the exciter with charge rate controlled by an automatic two-step regulator.

The engine shall be of the — cycle, — cooled type with — cylinders and a displacement of — cubic inches. It shall have a rating of — horsepower maximum at the operating speed of — rpm. The engine shall be provided with automatic choke, 12-volt battery ignition and gear-driven distributor.

The line transfer control panel shall be wall mounted and contain a magnetically held transfer switch, relays to automatically start the engine upon power failure, and shall provide a cranking limiter to open the starting circuit after about 45 seconds if the engine has failed to start. A four-position control switch shall permit selection of "stop", "hand cranked", "test", and "automatic" positions. The control panel shall contain a 12-volt battery trickle charger to maintain starting batteries fully charged.

The generator unit shall contain an instrument panel with a water temperature and oil pressure gauge, battery charge rate ammeter, 12-volt panel light, stop and start buttons, manual reset circuit breaker, necessary voltmeters and ammeters and a duplex twist tight type receptacle outlet.

The complete emergency standby generator unit shall be as manufactured by the — Company or approved equal.

Installation

All conductors for systems A, B-1 and B-2 must be installed in metal raceways or armored cable. No conductors of other feeders or branch circuit wiring shall be installed in the same raceways, outlet boxes, wireways or cabinets supplying the emergency lighting systems.

Switches

The switch for turning emergency lighting circuits "on" or "off" at the opening or closing of a theatre or other occupancy must, except as noted later, be limited to one switch accessible only to authorized persons. This

switch should preferably be located in the lobby or other place convenient to the main entrance of the building. This requirement will usually necessitate the installation of an emergency lighting panelboard that contains a remote-controlled master switch. A remote-control switch designed to operate this master switch can thus be placed in the lobby to meet the foregoing requirement. When the emergency lighting system only requires one to three branch circuits, a single or multi-pole switch can be provided in the lobby for directly controlling the several circuits. A feeder control switch for manually switching a group of emergency circuits from the lobby is not recommended, and in most cases requires a considerable increase in the length of the feeder conductors and raceway.

It is permissible to provide a separate switch for controlling one or more circuits supplying exterior lights.

Low Voltage System

System B-3 may involve runs of considerable length to scattered outlets. When low voltage auxiliary batteries are used, the conductors should be of adequate size to avoid excessive voltage losses and to prevent a corresponding reduction of illumination intensity.

The service equipment for emergency lighting systems must be so connected that it will not be interrupted by the disconnecting of normal service equipment devices or by the functioning of normal service equipment overcurrent devices, except for the momentary delay while automatic throw-over devices are functioning. Only the emergency service overcurrent devices shall be placed ahead of the emergency branch circuit overcurrent protective devices.

6.82 Storage Battery System

Auxiliary storage battery systems of approved type and capacity may be provided instead of, or in addition to, independent sources for emergency lighting. These batteries must also be provided with an automatic throw-over switch, and they must further be automatically maintained at a fixed minimum state of charge. These systems normally operate at 105 to 120 volts.

Furnish and install a complete emergency unit as indicated on the drawings. This standby unit shall consist of a storage battery, of suf-

ficient capacity to carry the total emergency load for a period of two hours; a storage battery control panel to operate with current available at the building, and a suitable means for charging and maintaining the battery in a fully charged condition.

Storage battery: The storage battery shall consist of 60 cells, and shall be able to deliver the required amperes for a period of two hours, when fully charged, to a final voltage of not less than 105-volts across the battery terminals.

Control cabinet: The automatic control cabinet shall contain a double-pole automatic switch which will transfer the emergency circuit from the normal supply to the battery circuit upon failure of the normal supply and automatically reconnect the emergency circuit to the normal supply when the service is restored. This automatic switch shall have a safe carrying capacity for the total connected load. It shall be so mounted that it will be accessible for parts replacement or necessary adjustments.

On the face of the cabinet there shall be mounted a voltmeter, a milliammeter to read the battery charge rate and a switch for control of the emergency circuit.

Circuit protection shall be provided for protection of the normal supply circuit, and the charging device of the same type as specified for panelboards.

A rectifier, capable of charging the 60 cell storage battery described above, in one series, shall be mounted in the cabinet in such a way that it will be accessible. It shall be designed for the current available and shall be capable of charging the battery at an approximately average rate of 4.6 amperes. This charger, when connected through proper resistance which shall be provided in the cabinet, shall be capable of trickle charging the battery at the proper rate. All equipment shall be left in operating condition.

Copies of instructions describing in detail the maintenance, care and operation of the equipment shall be furnished.

The storage battery emergency standby unit shall be as manufactured by the — Company or equal.

7.1 Signal, Communication and Auxiliary Systems

7.12 Radio and Television Antenna Systems

A. Television, multicoupler, non-amplified.

B. Television, amplified.

General

Furnish and install a (trade name and/or number) television antenna system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications and left completely equipped and in first class operating condition.

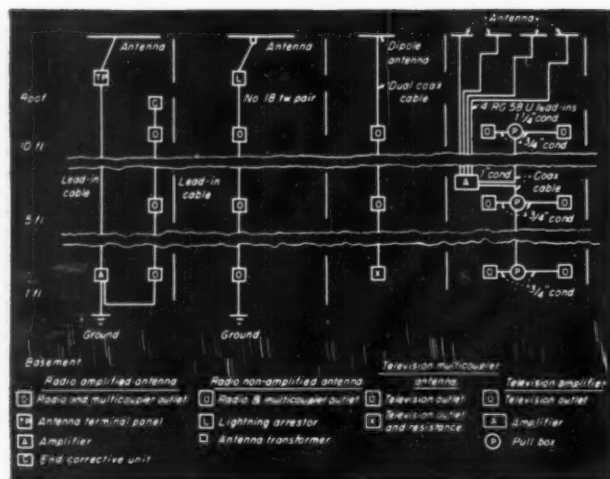
A. Television antenna system, multicoupler non-amplified: Install a dipole antenna of the required type with down-lead coaxial cable, riser coaxial cable, multicoupler outlets, terminal resistors and ground wire. This antenna shall be properly supported and braced. It shall clear the roof by 15 feet. Outlets shall be installed at locations shown on plans. Grounding of the support shall be made to the nearest cold water pipe.

B. Television antenna system, amplified: Install custom built television antennas for channels (mention channel numbers) as desired, each antenna shall be de-

signed to match the coaxial cable transmission line, and shall be located so as to receive clear signals and provide high quality pictures. The FM antenna shall be designed for reception of all locally receivable signals in the FM band. Wiring from each antenna to the amplifier units shall be in a coaxial cable as recommended by the manufacturer. The system shall be complete with television set outlets and ground wire. The antennas shall be properly supported and braced. They shall clear the roof by at least 15 feet and be arranged so that there will be no interference between antennas.

SIGNAL SYSTEMS PROSPECTS

Type System	Apartments	Bank	Bowling Alley	Church	Court House	Department Store	Dormitory	Estate	Home - Aged	Hospital	Hotel	Industrial	Mansion	Mortuary	Museum	Office Building	Prison	Public Building	Residence	School	Small Store	Theatre	Warehouse
Air Horns								x				x				x							
Burglar Alarm	x			x	x		x	x			x	x		x	x			x		x		x	
Call Systems	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x				x	x	
Clocks		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x		x	x
Door	x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x
Fire Alarm Automatic							x	x	x	x	x	x		x		x	x	x					x
Fire Alarm Manual	x			x	x	x	x	x	x	x	x	x		x	x	x	x		x		x	x	
Hold-Up Alarm	x				x					x								x				x	
In and Out	x							x	x	x			x			x							
Interphones	x	x		x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x		x	x
Nurses Call								x	x		x						x						
Paging—Audible						x					x												x
Paging—Silent	x				x		x		x						x			x				x	
Paging—Voice						x				x	x	x											
Program						x	x					x			x		x			x			x
Psychiatric										x													
Sirens	x							x				x					x						
Sprinkler Alarm						x		x			x	x				x	x	x					x
Sound Systems				x		x	x	x	x	x	x	x	x		x		x			x		x	
Tank Alarm	x							x	x			x			x	x	x	x				x	x
Watchman's Tour		x			x	x	x	x	x	x	x	x			x	x	x	x					x



Riser layout radio and television antenna systems.

Equipment

Aa. Install in each suite where shown a television set outlet on two-gang metal (or plastic) plate for connecting the set to the antenna and to power. At the end of the riser dual coaxial cable the set outlet shall contain a terminal resistor unit.

Ab. Install where shown on roof a complete dipole antenna of the all-channel, broad band and high gain type and connect to the dual coaxial cable. The down-lead shall be carried in conduit within the building. A terminal resistor unit shall be connected at the end of each riser.

Ca. Install in each suite where shown a television set outlet on two-gang metal (or plastic) plate for connecting the set to the antenna and to power.

The outlet device for television shall be designed to completely isolate all apartments from each other, so that a short circuit, open circuit or a defective television receiver connected to any receiver outlet, shall not affect the operation of any other television receiver connected to the system. The receiver outlet shall have a compensating attenuation network, so that the signal level in the last apartment on the coaxial transmission line will be approximately the same as that of the first apartment on the transmission

line. The signal level at the outlets shall not be less than 1,000 microvolts on the various television channels.

Cb. Install a multi-channel amplifier where shown in ventilated steel cabinet. This shall consist of a heavy duty power supply unit, a separate amplifier for each television channel and a separate amplifier for the FM channel. Provision shall be incorporated in the amplifier so that additional television channels may be installed if necessary in the future. The amplifier shall be designed for continuous duty and shall consume not more than 300 watts of power when operated on a 125 volt 60 cycle line. A filter shall be incorporated to eliminate all FM and diathermy interferences from the television channels.

Cc. Distribution transformers shall be completely wired in suitable steel cabinet and equipped with coaxial receptacles and plugs for connection of incoming and outgoing cables. All wiring from amplifiers to distribution transformers and from distribution transformers to outlets shall be coaxial transmission cable.

Cd. Install where shown on roof necessary number of antennas to provide service on all television channels specified. These shall be of the directional type having broad band and high gain and connected to coaxial cable.

Operating Current

All power outlets for sets shall be connected to the lighting system in the suites. Amplifiers shall be connected to separate circuit from nearest lighting panel supplying current to the building proper.

Wiring

All wiring shall be run in approved conduit in the same manner as for the lighting system. The lead-in or down-lead wires for television shall be coaxial cable of the size and type as recommended by the manufacturer of the antenna system. Wires for ground connection shall be as recommended by the manufacturer of the antenna system. Coaxial cable shall be run in continuous lengths from the antenna (or amplifier) and looped, not severed, through each television outlet in accordance with the riser diagram.

7.13 Intercommunicating Telephone Systems

- A. Two station.
- B. Master selective ringing and common talking.
- C. Master selective ringing and common talking, program and signal control.
- D. Selective ring and common talking.
- E. Selective ring and selective talking.
- F. Private exchange, manual switch-board.
- G. Private exchange, automatic switching.
- H. Apartment selective ringing and common talking, vestibule to suites, suites to door-opener. (1) loudspeaking, (2) non-loudspeaking.

General

Furnish and install an (trade name and/or number) intercommunicating telephone system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications and left in first class operating condition.

Operation

- A. Two station system: At the two locations shown there shall be a telephone arranged so that one station

may call and converse with the other. A pushbutton shall be provided with each unit. Pressing the button at one station shall ring the bell at the other station. Lifting the handphne (or receiver) completes the talking circuit.

B. Master selective ringing and common talking: In the main office where shown there shall be a master telephone with pushbuttons (or selector switch) to selectively call any outlying telephone. At other locations the telephone shall have a pushbutton (or selector switch) to call the master station. The master station after being called by an outlying station may call another outlying station to complete a connection between the two remote points. Only one conversation at a time is required.

C. Master selective ringing and common talking, program and signal control: In the main office where shown, there shall be a master telephone with pushbuttons to selectively call any outlying telephone by sounding the same buzzer in classroom clocks and bells at other locations as are used in the program system. At all other locations except in principal's office the telephone shall be furnished without a pushbutton or audible signal. Lifting the receiver on any outlying telephone shall sound a buzzer or lamp as desired at the master telephone. The master station after being called by an outlying station may call another outlying station to complete a connection between the two remote points. Only one conversation at a time is required. It shall be possible at the master station to transfer the audible signals from one program circuit to another without disturbing the overall program setting or any of the wiring.

D. Selective ringing and common talking system: At each location shown there shall be a telephone arranged for calling and conversing with any other telephone in the system. Each station shall be provided with pushbuttons (or selector switch) for selectively ringing any other station. Only one conversation at a time is required.

E. Selective ringing and selective talking system: At each location shown there shall be a telephone arranged for calling and conversing with any other telephone in the system. Each station shall be provided with pushbuttons (or selector switch) for selectively ringing and selectively talking with any other station in the system. It shall be possible to use all telephones simultane-

ously provided that the called station is not pre-occupied.

F. Private exchange, manual switchboard system: In the switchboard operator's room there shall be a common return, lamp signal type manual switchboard arranged to call and interconnect any telephone in the system. At other locations where shown there shall be a telephone of the type designated by the symbol. The telephone operator may call and converse with any outlying station, and any outlying station may call and converse with the operator, or be connected through the switchboard so that two outlying telephones may converse. Removing the handphne (or receiver) on any outlying station will cause its associated lamp to light at the switchboard. Connection from one line to another may be made by inserting the plugs of the cross-connecting cords into the calling and called station line jacks. Operator listens and converses through a headset and breast-plate transmitter or handset, connecting into individual cross-connecting sets by means of listening and ringing keys. Each set of cross-connecting cords shall be provided with supervisory lamps to indicate completion of a conversation between two stations. A buzzer and switch shall be provided as a night signal.

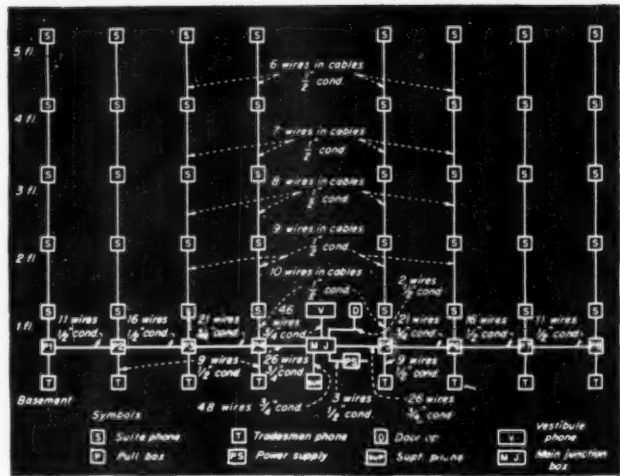
G. Private exchange, automatic switching system: In the machine room in basement there shall be a complete automatic exchange unit. This shall consist of an automatic relay (or step-by-step) switching unit, cable dis-

tribution rack, rectifiers, control panel and battery with rack. At other locations where shown there shall be an automatic dial type telephone of the type designated by symbol. The system shall enable any station in the system to call and converse with any other station without the assistance of an operator. Lifting a handphne (or a receiver) on the calling station and dialing the desired number shall automatically ring the called station. The talking circuit is completed when the handphne (or receiver) is lifted at the called station. A busy signal shall be audible in the handphne (or receiver) of the calling station when the called station lines are preoccupied.

H. Apartment selective ringing and common talking system, vestibule to suites, suites to door-opener: In each tenant's suite there shall be a telephone. A pushbutton shall be provided thereon to operate the door-opener at the main entrance. In the vestibule there shall be a telephone and plate with pushbuttons and card-holders for every suite in the building. Pressing a pushbutton thereon will cause a bell to ring in the corresponding suite telephone. Only one conversation is required at one time. Provide a buzzer in each suite telephone to operate from a pushbutton at the entrance to the suite.

Equipment

Aa. Install at each location in office a handphne on cradle type



Riser layout for apartment telephone system.

desk (or flush or surface wall mounting with handphoned or with watchcase receiver and built-in transmitter) telephone having mounted thereon a pushbutton for calling the other telephone on the system. (Provide desk unit with 6 feet flexible cable, terminal strip box and buzzer signal)

Ba. Install in office where shown a master handphoned on cradle desk (or flush or surface wall mounting with handphoned or with watchcase receiver and built-in transmitter) telephone having mounted thereon —pushbuttons (or selector switch with—points) to call all outlying stations. At all other locations install the type of telephone indicated by symbol having mounted thereon one pushbutton (or selector switch with one point) to call master station. (Provide desk unit with 6 feet flexible cable, terminal strip box and buzzer signal)

Bb. Install in or near power supply a retardation coil and connect to telephone system.

Ca. Install in office where shown a master telephone with handset mounted on a signal control board, flush or surface wall mounting, having the required number of pushbuttons and associated cardholders for every outlying telephone and other audible signals used in the program system. Adjacent to each pushbutton there shall be a set of openings each one representing a program circuit. A complete set of plugs shall be furnished, made to fit in these openings, and permitting internal connections from one program circuit to another, by means of horizontal circuit bars and vertical program circuit bars. A buzzer and a pilot lamp signal shall be provided on this unit with control switch so that either may be used as a signal. At all outlying points install the type of telephone indicated (flush wall, flush plug-in or surface wall) by symbol without signal. Where cradle desk telephones are shown provide same with 6-foot flexible cable, terminal strip box and associated buzzer signal.

Da. Install at each location where shown a handphoned on cradle type desk (or flush or surface wall mounting with handphoned or with watchcase receiver and built-in transmitter) telephone having mounted thereon—push-

buttons (or selector switch with—points) to call any other telephone in the system. (provide desk unit with 6-foot flexible cable, terminal strip box and buzzer signal; others with bell signal)

Db. (same as paragraph Bb.)

Ea. Install at each location where shown a handphoned on cradle type desk (or flush or surface wall mounting with handphoned) telephone having mounted thereon —locking pushbuttons (or reset selector switch with—points) to call any other telephone in the system. (Provide desk unit with 6-foot flexible cable, terminal strip box and buzzer signal; others bell signal)

Fa. Install at each location where shown a handphoned on cradle type desk (or flush or surface wall mounting with handphoned or with watchcase receiver and built-in transmitter) telephone. (Provide desk unit with 6-foot flexible cable, terminal strip box and buzzer signal; other with bell signal)

Fb. Install in telephone switchboard room a free-standing (or turret or desk type) common return, lamp signal, manual telephone switchboard. This unit shall be equipped for—line and lamp jacks (for all stations plus 10%) or nearest largest standard switchboard manufactured,—cross-connecting cords and ringing and listening keys, (based on 5 for first 50 lines plus 1 for each 10 additional lines) buzzer and switch, headset and breastplate transmitter with cord and plug, line terminals in rear. The cross-connecting cords shall be complete with supervisory pilot lamps.

Ga. Install at each location where shown a handphoned on cradle desk (or flush or surface wall mounting with handphoned) telephone with automatic dial and ringer. (Provide desk unit with 6 feet flexible cable and terminal block)

Gb. Install in machine room a complete automatic exchange unit. The machine switching equipment shall be fully equipped for—lines plus 25% space for future expansion, including switching and rack facilities, ringing apparatus, rectifier equipment, battery and rack.

Ha. Install in each suite a flash (or surface) wall type telephone provided with one pushbutton and

cardholder. (1) a talk and answer speaker mounted behind grille front with press-to-talk button, (2) a watchcase receiver and built-in transmitter and hook-switch, (1, 2) together with necessary terminals and backbox.

Hb. Install in vestibule a (1, 2) loudspeaking telephone, (2) non-loudspeaking telephone with armored cord receiver and built-in transmitter, (1, 2) with ——— pushbuttons and cardholders (one for each suite) and flush louvered lamp for illuminating plate. Outer frame shall be designed to contain government approved mailboxes. Backbox to be provided for the telephone in vestibule.

Hc. Install a mortise type door-opener in main entrance door frame and fasten securely in place, and even with door lock.

Terminal Strip Cabinets

Furnish and install where shown on plans, flush steel cabinets with hinged doors equipped with lock and keys. The terminal strips shall have sufficient pairs of terminals for all conductors, plus 10% spares. Terminal strips must be mounted on a sheet of insulating material.

Operating Current

The system shall operate from a dry plate rectifier power supply cabinet with a capacity of sufficient size to carry the load of the system. This unit shall have an input of 115 volts 60 cycle ac derived from a separate circuit from the nearest lighting panel. (H) a float-on-line dry plate rectifier charger and a storage battery, the rectifier to be capable of a booster charge if required.

Wiring

All wiring shall be run in approved conduit in the same manner as for the lighting system. The wire shall be color-coded and in general shall be standard heavy braided type, except in damp locations (or underground where it shall be lead-covered.) (A, twisted pair No. 19 B & S gauge, (B, D, G, H) cable with 2 pair No. 18 B & S gauge, balance single or paired No. 2 B & S gauge, (F, G) cable with pairs No. 22 B & S gauge, branches

twisted duplex or triplex No. 19 B & S gauge. (D) one twisted pair No. 19 B & S gauge, one common No. 14 B & S gauge, plus 1 No. 18 B & S gauge for each signal.

Finish

Finish on instruments shall be standard insofar as possible except annunciators and manual switchboards which shall be as approved by the Architect.

7.14 Sound Systems

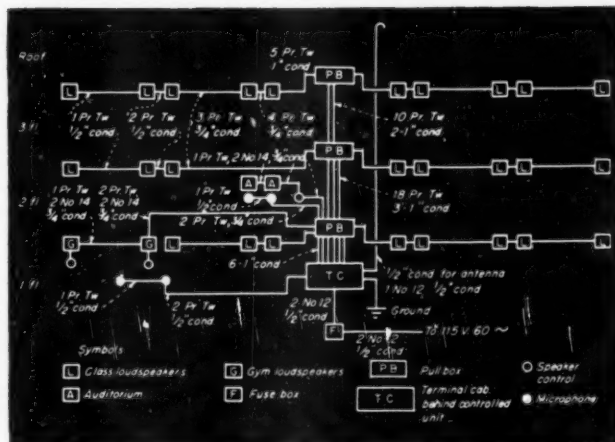
- A. Single channel.
- B. Multi channel.
- C. Intercommunication, two station.
- D. Intercommunication, master selective ringing, common talking.
- E. Intercommunication, selective ringing, common talking.
- F. Intercommunication, selective ringing, selective talking.

General

Furnish and install a (trade name and/or number) sound channel (or sound intercommunication) system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications and left in first class operating condition.

Operations

A. Single channel sound system: Install a single channel sound distribution system providing facilities for the distribution of a radio, phonograph or microphone program to any individual, selected group or all loudspeakers in the system. Install in a free-standing cabinet where shown in special room, complete receiving and distribution equipment and a microphone. It shall be possible to supervise rooms by means of a monitoring loudspeaker and to carry on a two-way conversation with an outlying station by operating a "talk-listen" switch and talking into the microphone. Install additional microphones in principal's office and on stage in auditorium. Install in each classroom a loudspeaker of the permanent magnet dynamic type. Install in the auditorium two high fidelity dynamic loudspeakers with directional horns mounted behind grille, one on each side of the stage, and provide with volume control.



Riser layout school sound system.

B. Multi channel sound system: (Similar to paragraph A. except for additional radio and distribution equipment for two or more channels)

C. Intercommunication, two-way sound system: At the two locations shown on plans there shall be a sound intercommunicator arranged so that one station may call and converse with the other. A "press-to-talk" switch shall connect the speaker-microphone so that the calling station may converse with the called station. A separate key or switch shall be used for signaling the called station.

D. Intercommunication, master selective ringing, common talking system: In the manager's office there shall be a sound intercommunicator of the master type arranged so that any outlying station may be called individually or for conference by operating an individual or all calling buttons. By operating the "press-to-talk" switch the speaker-microphone is connected to any or all outlying stations. The outlying stations have a calling button to call the master station and a "press-to-talk" switch for conversing.

E. Intercommunication, selective ringing, common talking system: In each office where shown on plans there shall be a sound intercommunicator of the multiple type arranged so that any station may call and converse with any other station in the system. A "press-to-talk" switch shall connect the speaker-microphone so that the calling station may converse with the called station. A separate key or switch shall

be used for calling each of the other stations individually. (A conference key may be provided at one station to talk to a group or all of the other stations). Only one conversation at one time is required normally.

F. Intercommunication, selective ringing, selective talking system: In each office where shown on plans there shall be a sound intercommunicator of the selective type arranged so that any station may call and converse with any other station in the system. A "press-to-talk" switch shall connect the speaker-microphone so that the calling station may converse with the called station. A separate key or switch shall be used for calling each of the other stations individually. (A conference key may be provided at one station to talk to a group or all of the other stations). As many conversations as there are pairs of stations are required normally.

Equipment

Aa. Install in each classroom a semi-flush permanent magnet dynamic type loudspeaker with an 8-inch cone and baffle in walnut case. In laboratories, gymnasium and science rooms install a 10-inch loudspeaker in same type of case. In auditorium install two high fidelity dynamic loudspeakers with directional horns equipped with a 12-inch fidelity cone. Provide a volume control unit in auditorium and gymnasium for loudspeakers.

Ab. Install on stage in auditorium a three-way polarized microphone receptacle with single gang metal plate, and a velocity microphone with switch mounted on an adjustable floor stand with 30 feet of cord and a plug. Install a microphone in the principal's office to be of the desk type complete with 10-foot cord, plug and receptacle.

Ac. Install in room where shown a free-standing cabinet containing the necessary voltage amplifier, power amplifier, radio receiver, phonograph reproducing unit, distribution switch panel, monitor loudspeaker and all controls for regulating volume and tone. The radio receiver shall be superheterodyne having high sensitivity over the entire broadcast, shortwave and frequency modulation bands. The phonograph reproducing unit shall be of the automatic record ejector type, suitable for playing a multiple of records at either 78, 45 or 33 1/3 rpm. The monitor loudspeaker shall be of the 8-inch permanent magnet dynamic type and be provided with "talk-listen" switch for two-way conversation. Provide dynamic microphone with switch complete with desk stand, cable and plug.

Ba. (Same as paragraph Aa.)

Bb. (Same as paragraph Ab.)

Bc. (Similar to paragraph Ac. except with facilities for desired number of channels)

Ca. Install where shown a desk model amplified sound intercommunicator consisting of wood (or plastic) case and having mounted therein a speaker-microphone and amplifier. The surface of the case shall have a "press-to-talk" switch, a calling key or switch, a volume control switch and watchcase receiver and hook. Provide 6 feet of cable and plug.

Da. Install in manager's office a desk model amplified intercommunicator consisting of wood (or plastic) case and having mounted therein a speaker-microphone, amplifier and terminals. The surface of the case shall have a "press-to-talk" switch, calling keys or switches, (name, number) a volume control switch and watchcase receiver and hook. Provide 6 feet of cable and plug.

Db. Install in all other offices where shown a desk model ampli-

fied intercommunicator outlying station consisting of wood (or plastic) case and having mounted therein a speaker-microphone, amplifier and terminals. The surface of the case shall have a "press-to-talk" switch, a calling key or switch, a volume control switch and watchcase receiver and hook. Provide 6-foot cable and plug for power, and flexible cable and terminal block for circuit wiring.

Ea. Install in all offices where shown a desk model amplified intercommunicator for selective ringing and common talking consisting of wood (or plastic) case and having mounted therein a speaker-microphone and amplifier. The surface of the case shall have a "press-to-talk" switch, calling keys or switches, (name, number) a volume control switch and watchcase receiver and hook. Provide 6 feet of cable and plug for power, and flexible cable and terminal block for circuit wiring.

Fa. Install in all offices where shown a desk model amplified intercommunicator for selective ringing and selective talking consisting of wood (or plastic) case and having mounted therein a speaker-microphone and amplifier. The surface of the case shall have a "press-to-talk" switch, calling keys or switches, (name, number) a volume control switch and watchcase receiver and hook. Provide 6 feet of cable and plug for power, and flexible cable and terminal block for circuit wiring.

Terminal Strip Cabinets

Furnish and install where shown on plans, flush steel cabinets with hinged doors equipped with locks and keys. The terminal strips shall have sufficient pairs of terminals for all conductors plus 10% spares. Terminal strips must be mounted on a sheet of insulating material.

Operating Current

The system shall operate on 115 volts 60 cycle ac (A,B). A separate circuit shall be run from the nearest lighting panel, (C,D,E,F). The intercommunicators shall be plugged into the nearest convenience receptacle by means of the flexible cord and plug provided with the units.

Wiring

All wiring shall be in approved conduit in the same manner as for the lighting system. The wires from the source of current shall be rubber covered. (A,B) 2 No. 14 B & S gauge, (C,D,E,F) 2 No. 18 B & S gauge in flexible cord with plug. (A,B) Wiring from the main terminal cabinet adjacent to the control cabinet shall be in flexible cable supplied by the manufacturer of the system. Wiring from the main terminal cabinet to individual room loudspeakers shall be 2 No. 18 B & S gauge rubber covered and cotton braid with steel shield. Wiring to auditorium speakers shall be 2 No. 14 B & S gauge and 2 No. 18 B & S gauge. Wiring to auditorium volume control 5 No. 16 B & S gauge. Wiring to auditorium microphone receptacle 1 lead sheathed covered twisted pair No. 19 B & S gauge in separate conduit. Ground wire No. 12 B & S gauge from control cabinet to street side of water meter, 2 No. 14 B & S gauge from nearest lighting panel to control cabinet. Antenna lead-in wires to be carried from control cabinet to roof of building. (C) No extra wiring necessary. (D) Wiring between the master station and the outlying stations 3 common and 1 section to each outlying station No. 22 B & S gauge. (E) Wiring between all stations 3 common and 1 section to all No. 22 twisted. (F) Wiring between all stations 3 common and 1 pair section to all No. 22 twisted.

Finish

All cabinets shall be walnut (or some other standard finish) or as selected by the Architect.

7.15 Paging Systems

A. Lamp annunciator, three and six call.

B. Central code transmitter.

C. Voice, multiple circuit.

General

Furnish and install a (trade name and/or number) paging system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance

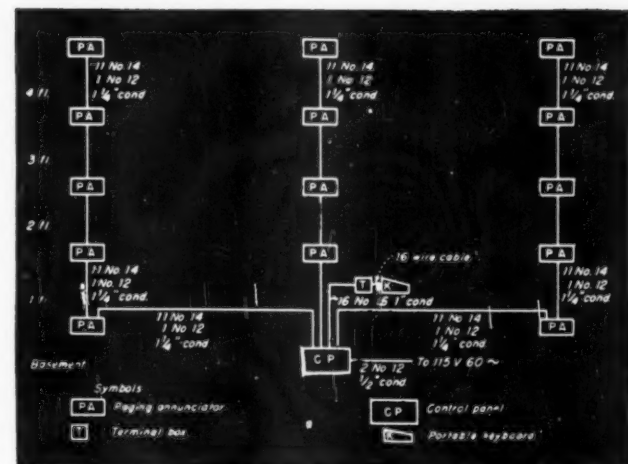
with the manufacturer's specifications, and left in first class operating condition.

Operation

A. Lamp annunciator: In corridors at intersections and nurses' stations, doctors' lounge, library, auditorium, nurses' dining room and at other locations shown on plans there shall be a paging lamp annunciator. There shall also be enclosed therein a buzzer (or chime may be mounted adjacent to annunciator) with externally controlled cut-off switch. Adjacent to telephone switchboard operator there shall be a portable keyboard with three vertical rows of keys for paging three persons, (six rows of keys for paging six persons) and provided with flexible cable to a flush terminal cabinet mounted in wall. Operation of the buttons in the same vertical row will light and flash correspondingly numbered simultaneously in all lamp annunciators and pilot lights on the keyboard. When more than one person is to be paged additional vertical rows of buttons are operated and coded lamp signals appear in sequence and flash. System shall have a capacity of 120 calls using three digit code numbers. Additional buttons shall be included to connect or disconnect the system and to operate the audible signals to obtain special attention. A control cabinet shall be installed in the machine room located in the basement for controlling the load and the sequence of calls and the flashing of the lamps. To extinguish the lamp signals the reset button on the respective vertical row is operated.

B. Central code transmitter, single call system: In corridors, stockrooms, shops and other locations shown on the plans there shall be a heavy duty bar chime (single stroke bell, buzzer, single or double projector vibrating horn). Adjacent to telephone switchboard operator there shall be an automatic motor-driven code transmitter with "on and off" switch and facilities for setting up a pre-determined series of codes or impulses. Only one signal may be transmitted at one time but may be repeated as long as desired. (Capacity of transmitter determined by the number of persons to be paged)

C. Voice, multiple circuit system: In corridors, stockrooms, shipping room, shops and other locations shown on the plans there shall be a loud-



Riser layout silent paging system with buzzer.

speaker. Adjacent to the telephone switchboard operator there shall be a desk type microphone with "press-to-talk" switch complete with flexible cable, plug and receptacle. In addition there shall be a paging selector keyboard which shall enable the operator to connect each individual, group or riser of loudspeakers. A master switch shall be included to connect all loudspeakers simultaneously regardless of the position of the other switches.

Equipment

Aa. Install at each location where shown a lamp annunciator with suitable mounting for the locality. Case shall be of heavy steel construction with hinged doors. Single face flush, double and triple face vertical wall bracket mounted annunciators shall have ten lamps each. Double face ceiling or suspended horizontal mounting and double face partition mounted annunciators shall have two sets of ten lamps each. Size of indicators shall not be less than two inches high and shall have markings applied photographically or engraved on plastic sheet. Markings shall be 1 to 9 and 0. Buzzer shall be mounted in lower part of case and cut-off switch handle shall extend through bottom of case. (Where chime is mounted adjacent to annunciator, buzzer is omitted and two terminals are provided for extension) Backbox to be provided by the manufacturer.

Ab. Install where shown a portable selector keyboard consisting of three (or six) rows of metal locking buttons or switches, each button in a row representing a single digit indication on the annunciators, and arranged in a vertical position parallel to each other. In addition there shall be a "start" and a "stop" button, and an audible signal switch at the bottom of each vertical row. This unit shall be mounted on a 30-inch cast iron floor pedestal (or a table as selected). A flexible cable 10 feet long shall be connected and brought out to a flush terminal cabinet for connection to the permanent wiring.

Ac. Install where shown a control panel enclosed in a surface steel cabinet with hinged door and lock with keys. This panel shall contain the necessary silent mercury contact relays, transformer for keyboard control, fuses, master switch and terminals.

Ba. Install where shown a heavy duty single stroke bar chime, single stroke bell (with 4, 6 or 10 inch gong) non-contact buzzer, single or double projector vibrating horns as indicated by symbol. These units shall be wound to operate in multiple on the maximum voltage of the system. These shall be designed to mount on standard outlet boxes.

Bb. Install where shown a synchronous motor-driven automatic code transmitter having an "on and

off" switch, and a selector key-board or dial for setting the transmitter to call desired person. Index card or sheet shall be provided thereon for inserting the names of the individuals. A flexible cord and plug shall be provided for connection to a 115 volt 60 cycle convenience receptacle, and another cord shall be provided to connect to the signal circuit.

Bc. Install where shown a silent mercury contact relay or relays enclosed in surface steel cabinet with hinged door and equipped with lock and keys, and connect with operating pushbutton. Relays shall be of sufficient size to carry the load of the entire signal devices.

Ca. Install where shown a permanent magnet, dynamic type loudspeaker single face flush, surface wall, double face wall bracket mounting or portable desk mounting as indicated by symbol. These speakers shall be equipped with volume control device and shall be of sufficient volume and size to be distinctly heard over the area in which they are installed.

Cb. Install where shown a portable type adjustable desk stand crystal microphone complete with flexible cable, plug and receptacle. A "press-to-talk" switch shall be provided on the microphone. (A floor type switch may be supplied with connecting cord to free operator's hands).

Cc. A selector keyboard shall be provided with the microphone consisting of a portable cabinet containing a heavy duty switch for each individual, group or riser of loudspeakers and equipped with a flexible cable and terminal block in surface housing. A master switch shall also be provided below circuit switches.

Cd. Install where shown a voice paging amplifier equipped with volume control, tone control, power switch, protecting fuses, multi-tap output transformer, and receptacle for microphone, enclosed in ventilated steel cabinet. This unit shall be of ample capacity to operate the entire system.

Terminal Strip Cabinets

Install where shown on plans flush steel cabinets with hinged doors equipped with lock and keys. The terminal strips shall have suf-

ficient pairs of terminals for all conductors plus 10% spares. Terminal strips shall be mounted on a sheet of insulating material.

Wiring

All wiring shall be run in approved conduit in the same manner as for the lighting system. The wires shall be color-coded and rubber covered. Feeder wires to control cabinets and relay cabinets shall be No. 10 B & S gauge. (A) Number of wires between the control cabinet or relay cabinet to annunciators 11 without audible signals, and 12 with audible signals, with common feeder wire No. 12 B & S gauge and lamp and audible signal section wires No. 14 B & S gauge. (A) Number of wires between the keyboard and relay cabinet 11 without audible signals, and 12 with audible signals, with common feeder wire No. 12 B & S gauge and lamp and audible signal section wires No. 14 B & S gauge for single call. Keyboard to control panel 15 wires without audible signals, and 16 with audible signals No. 16 B & S gauge for 3 to 6 call. (B) Number of wires between the relay cabinet and sounding devices 2 not smaller than No. 14 B & S gauge. (C) Number of wires from amplifier to loudspeakers 1 No. 18 B & S gauge rubber covered twisted pair (based on small installation in separate conduit: shielded wire if run in conduit with other systems). Number of wires from amplifier to loudspeakers 1 No. 18 B & S gauge rubber covered twisted pair for each separate section of loudspeakers. The amplifier requires 1 pair of No. 14 B & S gauge wires from the source of supply.

7.16 Fire Alarm Systems

- A. Non-code, open-circuit, non-supervised.
- B. Non-code, closed-circuit, supervised.
- C. Master-code, closed-circuit, supervised.
- D. Plain-code, closed-circuit, supervised.
- E. Single-code, group, closed-circuit, supervised.
- F. Coded pre-signal, closed circuit, supervised.
- G. Coded shunt non-interfering, closed-circuit, supervised.

H. Coded positive non-interfering, closed-circuit, supervised.

I. Coded auxilialized, Municipal connection.

J. Non-code, automatic, closed-circuit, supervised, (1) Wired, (2) Tube

K. Coded, automatic, closed circuit, supervised, (1) Wired, (2) Tube.

General

Furnish and install a (trade name and/or number) fire alarm system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications, and left in first class operating condition.

Operation

A. Non-code, open-circuit, non-supervised system: At each stairway, exit and other locations shown on plans there shall be a non-code break-glass fire alarm station. At each location where shown there shall be a bell (or horn). Breaking the glass in any station shall cause all sounding devices to operate continuously until the glass has been replaced in the station which initiated the alarm. It shall also be possible to transmit a test signal from any station by opening the front cover by means of a key.

B. Non-code, closed-circuit, supervised system: At each stairway, exit, and other locations shown on plans there shall be a non-code break-glass fire alarm station. At each location where shown there shall be a bell (or horn or siren). Breaking the glass in any station shall cause all sounding devices to operate continuously until the glass has been replaced in the station which initiated the alarm. It shall also be possible to transmit a test signal from any station by opening the front cover by means of a key. The stations and the sounding devices shall be connected to a control panel which shall permit a small supervisory current to pass through the entire system. A trouble bell shall also be provided and shall sound continuously in the event of interruption of the operating current, or a break in the system wiring or connections.

C. Master-code, closed-circuit, supervised system: At each stairway, exit and other locations shown on plans, there shall be a non-code break-glass fire alarm station. At each location

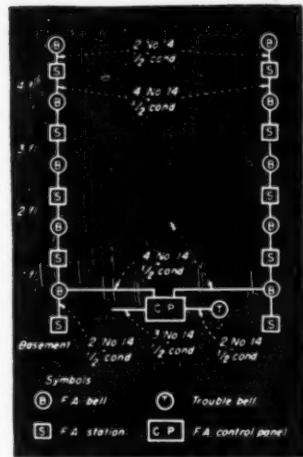
shown there shall be a bell (or horn). Breaking the glass in any station shall cause the master-code mechanism on the control panel to trip and transmit a common code on all sounding devices in the system. It shall also be possible to transmit a test signal from any station by opening the front cover by means of a key. The stations and the sounding devices shall be connected to a control panel which shall permit a small supervisory current to pass through the entire system. The trouble bell shall sound continuously until the glass is replaced in the station which initiated the alarm, and the master code mechanism has been rewound. The trouble bell shall also operate continuously in the event of interruption of the operating current, or a break in the system wiring or connections.

D. Plain-code, closed-circuit, supervised system: At each stairway, exit and other locations shown on plans there shall be a plain-code, closed-circuit, general alarm type fire alarm station. At each location shown there shall be a bell (or horn). Pulling and releasing the lever of any station shall cause the code number of that station to be sounded on all signal devices in the system. The stations and the sounding devices shall be connected to a control panel which shall permit a small supervisory current to pass through the entire system. It shall be possible to make a single tap test, and a silent running test on any station by operating an enclosed lever or by inserting a key into an opening provided therefore, and turning it in either of two directions. The bell shall sound in the event of interruption of current or a break in the system wiring or connections.

E. Single-code, group, closed-circuit, supervised system: At each stairway, exit and other locations shown on plans of the main building there shall be a single-code, closed-circuit fire alarm station. At each location shown there shall be a local or general alarm bell (or horn). In the service and employees buildings there shall be the same type of stations and sounding devices. Pulling and releasing the lever of a station in the main building shall cause the simultaneous operation of two separate spring contacts. One shall be used to operate the local alarm sounding devices in the main building, while the other shall be used to operate the general alarm sounding devices in

the service and employees buildings. Stations located in the service and employees buildings shall operate all local alarm sounding devices in the building where the alarm originates, and in addition operate all general alarm sounding devices in the other service and employees buildings and also in the main building. The stations and sounding devices in each building shall be connected to a separate group type control panel located in its respective building which shall permit a small supervisory current to pass through the entire system. It shall be possible to make a single tap test, and a silent running test on any station by operating an enclosed lever, or by inserting a key into an opening provided therefore, and turning it in either of two directions. The trouble bell shall sound at each control panel affected and operate continuously in the event of interruption of the operating current or a break in the system wiring or connections. A permanent record of each alarm shall be made on a punch register located near the control panel in the main building, together with the time of the day transmitted. This shall be accomplished by an automatic time stamp interconnected with the punch register.

F. Coded pre-signal, closed-circuit, supervised system: At each stairway, exit and other locations shown on plans there shall be a coded pre-signal, closed-circuit fire alarm station. At each location shown there shall be a general alarm bell or a pre-signal bell or chime as indicated. Pulling and releasing the lever of the station shall cause the code number of that station to be sounded on all pre-signal sounding devices only. Inserting a special general alarm plug in an opening provided therefor on the face plate containing the pull lever, and then pulling and releasing the lever, shall cause the code number of that station to sound on all signal devices, both pre-signal and general alarm throughout the system. The stations and sounding devices shall be connected to a control panel which shall permit a small supervisory current to pass through the entire system. It shall be possible to make a single tap test, and a silent running test on any station by operating an enclosed lever, or by inserting a key into an opening provided therefor, and turning it in either of two directions. The trouble bell shall sound continuously in the



Riser layout plain code fire alarm system.

event of interruption of the operating current, or a break in the system wiring or connections.

G. Coded shunt non-interfering, closed-circuit, supervised system: At each stairway, exit and other locations shown on plans there shall be a coded shunt non-interfering fire alarm station. At each location shown there shall be a bell (or horn). Pulling and releasing the lever of the station shall cause the code number of that station to be sounded on all signal devices in the system. The shunt non-interference feature shall function to insure that when a station is operating, no other station, electrically farther away from the control panel, shall interfere with its operation. The stations and sounding devices shall be connected to a control panel, which shall permit a small supervisory current to pass through the entire system. It shall be possible to make a single tap test, and a silent running test on any station by operating an enclosed lever, or by inserting a key into an opening provided therefor, and turning it in either of two directions. The trouble bell shall sound continuously in the event of interruption of the operating current or a break in the system wiring or connections.

H. Coded positive non-interfering, closed-circuit, supervised system: At each stairway, exit and other locations shown on plans there shall be a coded, positive non-interfering fire alarm station. At each location shown there shall be a bell (or horn). Pulling and

releasing the lever of the station shall cause the code number of that station to be sounded on all sounding devices in the system. The positive non-interfering feature shall function to insure that when a station is operating, no other station shall interfere with its proper transmissions of impulses. Should two or more stations be pulled at or about the same time, the station first securing the line will complete its code signal without interference from subsequently operated stations. The stations and sounding devices shall be connected to a control panel, which shall permit a small supervisory current to pass through the entire system. The trouble bell shall sound continuously in the event of interruption of the operating current or a break in the system wiring or connections until the defect is remedied. It shall not be possible to silence the trouble bell except by a throw-over switch on the control panel which automatically transfers the trouble signal to a red lamp also located on the panel. Lamp is to remain lighted until the trouble is remedied, then switch is to be returned to its normal position. A record of all alarms shall be made on a punch register and the time of such alarm shall be imprinted on the register tape by means of an automatic time stamp.

I. Coded, auxiliary, Municipal connected system: At each stairway, exit and other locations shown on plans there shall be a coded, auxiliary fire alarm station. At each location there shall be a bell (or horn). Breaking the glass in the door and pulling and releasing the lever of the station shall cause the code number of that station to be sounded on all signal devices in the system, and transmit the alarm simultaneously to the City Fire Department by tripping a City Master Fire Alarm Station located in the switchboard operator's office (or located on a pedestal on the street in front of the building). Interlocking contacts shall be provided on the station to prevent false alarms from being transmitted to the municipal system. For fire drills it shall be necessary to first open the station door by means of a key. The pulling of the lever under this condition shall only cause the signal devices to operate within the confines of the building. A warning signal shall be given on the control panel, immediately, when the glass is broken or when the door

springs open on a station. The trouble signal continues to operate as long as a station door remains open after transmitting an alarm or a drill signal. The stations and the sounding devices shall be connected to a control panel, which shall permit a small supervisory current to pass through the entire system. The system shall be double supervised using distinctively toned trouble bells, two in number, each with pilot lamps and silencing switches.

J. Non-code, automatic, closed-circuit, supervised system: In all rooms, corridors, closets, shops, storerooms, attic and other locations shown on plans there shall be mounted on the ceilings (1) thermostatic detectors of the rate-of-rise and fixed temperature type, (2) thermostatic detector tubing, (1, 2) properly spaced and installed to result in maximum protection in accordance with the Underwriters' requirements. At each location shown there shall be a bell (or horn). In the event of a fire the rapid rise in temperature shall be automatically detected by the thermostatic elements, which in turn shall cause all sounding devices to operate continuously throughout the system. The thermostatic elements and the sounding devices shall be connected to a control panel which shall permit a small supervisory current to pass through the entire wiring of the system. The trouble bell shall sound continuously in the event of interruption of the operating current or a break in the system wiring or connections until the defect is remedied. The trouble signal shall include a transfer switch and a pilot light. It shall be possible to make periodic tests on the thermostatic elements whenever desired.

K. Coded, automatic, closed-circuit, supervised system: In all rooms, corridors, closets, shops, storerooms, attic and other locations shown on plans there shall be mounted on the ceilings (1) thermostatic detectors of the rate-of-rise and fixed temperature type, (2) thermostatic detector tubing, (1, 2) properly spaced and installed to result in maximum protection in accordance with the Underwriters' requirements. At each location shown there shall be a bell (or horn), and an electrically tripped transmitter. In the event of a fire, the rapid rise in temperature shall be automatically detected by the thermostatic elements, which in turn shall cause a code signal to be sounded on all sounding devices, indicating

the zone or section of the system in which the alarm originated. The thermostatic elements and the sounding devices shall be connected to a control panel (which may also contain the transmitters on smaller systems). A small supervisory current shall pass through the entire wiring system. The trouble bell shall sound continuously in the event of interruption of the operating current or a break in the system wiring or connections, and, when the transmitters require winding and until the trouble is remedied. The trouble signal shall include a transfer switch and a pilot light. It shall be possible to make periodic tests on the thermostatic elements whenever desired.

Equipment

Aa. Install where shown a flush (or surface) non-code break-glass hammerless fire alarm station, with hinged front door and lock with key arranged for making tests without breaking glass, and for easy replacement of the glass when broken. Flush station shall mount on standard outlet box with single gang cover. (surface station is provided with back-casting by manufacturer)

Ab. Install where shown on plans an underdome vibrating plunger type bell (4, 6 or 10 inch size), or heavy duty type vibrating horn of the single or double projector type as indicated by symbol. These signal devices shall all be wound for multiple operation.

Ba. (Same as paragraph Aa.)

Bb. Install where shown an underdome vibrating plunger type bell (4, 6 or 10 inch size), or heavy duty type vibrating horn of the single or double projector type as indicated by symbol. These signal devices shall all be wound for series operation.

Bc. Install where shown a closed-circuit fire alarm control panel in surface (or flush) wall type steel cabinet equipped with hinged door with lock and keys. Panel shall contain all necessary relays, meter, resistances, thermal cut-out, terminals and fuses for the control and supervision of the system. Panel shall be single supervised (unless double supervised is specified) and shall operate on 115/230 volts, 3 wire supply current. Panel shall contain number of bell and station

circuits required. A trouble bell shall be provided for external connection.

Ca. (Same as paragraph Aa.)

Cb. Install where shown an underdome single stroke plunger type bell (4, 6 or 10 inch size) or heavy duty vibrating horns of the single or double projector type as indicated by symbol. These signal devices shall all be wound for series operation.

Cc. Install where shown a closed-circuit fire alarm control panel of the master type in surface (or flush) wall type steel cabinet equipped with hinged door with lock and keys. Panel shall contain all necessary relays, meter, resistances, thermal cut-out, four round master code mechanism, terminals and fuses for the control and supervision of the system. Panel shall be single supervised (unless double supervised is specified) and shall operate on 115/230 volts, 3 wire supply current. Panel shall contain number of bell and station circuits required. A trouble bell shall be provided for external connection.

Da. Install where shown a semi-flush (or surface or weatherproof) plain code, closed-circuit, pull lever, four round code type fire alarm station with break-glass (or open) door. Stations shall be provided with a code wheel, coded as required. Facilities shall be included for making a single tap test and silent running test with key. Backbox to be provided by the manufacturer.

Db. (Same as paragraph Cb.)

Dc. (Same as paragraph Bc.)

Ea. Install where shown a semi-flush (or surface or weatherproof) single code, closed-circuit, pull lever, four round code fire alarm station with break-glass (or open) door. Stations shall be provided with one code wheel, coded as required, two sets of contacts, and two sets of terminals. Facilities shall be included for making a single tap test and silent running test with key or lever. Backbox to be provided by the manufacturer.

Eb. (Same as paragraph Cb.)

Ec. Install where shown in main building a closed-circuit master fire alarm control panel. In other buildings install a closed-circuit local fire alarm control panel. Panels shall be mounted in surface (or

flush) wall type steel cabinets equipped with hinged doors with lock and keys. Panels shall contain all necessary relays, meters, resistances, thermal cut-outs, terminals and fuses for the control and supervision of the system in their respective areas. The system shall be single supervised (unless double supervised is specified) and shall operate on 115/230 volts, 3 wire supply current. Panels shall contain number of bell and station circuits required. Trouble bells shall be provided for external connections.

Fa. Install where shown a semi-flush (or surface) pre-signal, pull lever, four round type fire alarm station with break-glass (or open) door. Stations shall be provided with one code wheel, coded as required. A jack shall be provided on the pull lever plate for insertion of plug or key. Facilities shall be included for making a single tap test and silent running test with key or lever. Backbox for the installation to be provided by manufacturer.

Fb. (Same as paragraph Cb.)

Fc. (Same as paragraph Bc.)

Ga. Install where shown a semi-flush (or surface or weatherproof) plain code, shunt non-interfering, closed-circuit, pull lever, four round code type fire alarm station with break-glass (or open) door. Station shall be provided with a code wheel, coded as required, and with shunt circuit contact springs. Facilities shall be included for making a single tap test and silent running test with key or lever. Backbox to be provided by the manufacturer.

Gb. (Same as paragraph Cb.)

Gc. (Same as paragraph Bc.)

Ha. Install where shown a semi-flush (or surface or weatherproof) positive non-interfering, closed circuit, pull lever, four round code type fire alarm station with break-glass (or open) door. Stations shall be provided with a code wheel, coded as required and non-interference coil and contact springs. Backbox to be provided by the manufacturer.

Hb. Install where shown an underdome, single stroke, electro-mechanical bell with a 10-inch gong suitable for operation on a normally closed-circuit of 100 to 110

milliamperes direct current. Bells to have prewound mechanism capable of striking not less than 500 blows on one winding. At the location of the punch register install a 6-inch back-stroke tapper bell, wall mounting type to operate on same current requirements.

Hc. Install where shown a closed-circuit fire alarm panel in surface (flush or free-standing) steel cabinet, having hinged doors with lock and keys. Panel shall contain all necessary apparatus for the operation and supervision of the complete system, comprising the proper number of loops for the stations and bells. Each loop shall have its own set of instruments and arranged to entirely remove a loop from the circuit without affecting the remainder of the system. Provide double supervision for the circuits complete with trouble bells with pilot lights and silencing switches.

Ia. Install where shown a semi-flush (or surface or weatherproof) auxiliary, closed-circuit, pull lever, four round code type fire alarm stations with break-glass door. Stations shall be provided with a code wheel, coded as required and with municipal alarm interlocking contacts for sending an alarm. A cylinder lock shall be provided on the door to permit fire drills without sending alarms to the municipal system. Backbox to be provided by the manufacturer.

Ib. (Same as paragraphs Cb. or Hb.)

Ic. Install where shown a closed-circuit double supervised fire alarm control panel in surface (or flush) wall type steel cabinet equipped with hinged door with lock and keys. Panel shall contain all necessary relays, meters, resistances, thermal cut-out, terminals and fuses for the control and supervision of the interior system, and a special switch and separate terminals for connection to the municipal system. Panel shall operate on 115-230 volts 60 cycle ac, 3 wire supply current. Panel shall contain number of bell and station circuits required. Two trouble bells shall be provided for external connections together with trouble pilot lights and silencing switches.

Ja. Install where shown thermo-

static detectors of the rate-of-rise and/or fixed temperature type with open-circuit contacts and mounted on round outlet boxes and covers, for operation on 165° F. (or 212° F.) (2) thermostatic detector non-corrosive metal tubing with fitting and fastening facilities.

Jb. (Same as paragraph Bb.)

Jc. (Same as paragraph Bc.)

Ka. (Same as paragraph Ja.)

Kb. (Same as paragraph Bb.)

Kc. Install where shown a semi-flush (or surface) closed-circuit, combination pull lever and electrically tripped transmitter with break-glass door with four round code movement. Stations shall be provided with a code wheel, coded as required, and a trip coil. Back-box to be provided by the manufacturer.

Kd. (Same as paragraph Bc. when electrically tripped stations are used. Same as paragraph Cc. if electrically tripped movement is on control panel.)

Special Features

(D, E, F, G, H, I, K) Install where shown on plans a punch register, take-up reel and automatic time stamp mounted on shelf with overall enclosing glass cover and supported on metal brackets. Stamping coil of time stamp to operate on 115 volts 60 cycle ac.

Terminal Strip Cabinets

Install where shown a flush steel cabinet with hinged doors equipped with lock and keys. The terminal strips shall have sufficient pairs of terminals for all conductors plus 10% spares. Terminal strips shall be mounted on a sheet of insulating material.

Lightning Protection

Install in each building where overhead lines enter, lightning protectors on each line, and enclose same in surface steel cabinet.

Operating Current

The system shall operate from (A) a transformer having a capacity of — watts (based on 15 va for each sounding device), (A,B,C, D,E,F,G,I,J,K) 115 volts 60 cycle

ac, (H) a dry plate rectifier power supply with standby storage battery of proper voltage and current output mounted on battery rack, (A,B,C,D,E,F,G,H,I,J,K) connected directly to a separate circuit from the nearest lighting panel.

Install where shown a cut-out box, surface type of steel construction with hinged door with lock and keys. This cabinet shall contain the proper size fuse for each "hot wire" and provided with a solid neutral. Door shall be finished in red and stenciled with the wording "Fire Alarm".

Wiring

All wiring shall be run in approved conduit in the same manner as for the lighting system. The wires shall be color-coded and rubber covered. Feeder wires to control panels shall be No. 10 B & S gauge. All wires to fire alarm stations shall not be smaller than No. 14 B & S gauge. All wires to fire alarm sounding devices shall not be smaller than No. 14 B & S gauge (on large projects No. 12 B & S gauge). (A) Number of wires on 24 volt system between relay and sounding devices and stations 3. On transformer or 115 volts 2 wires to first sounding device and station, 3 thereafter. (B,C,D) Number of wires from control panel to combination of sounding devices and stations 4. (E,F,G,I) Number of wires between control panel and combination of sounding devices and stations 6. (H) Number of wires between control panel and series of sounding devices and stations 2. (J,K) Number of wires between control panel and thermostatic detectors 2.

Finish

The finish of all fire alarm stations and cabinets with control panels, terminal strips, fuses and lightning protectors shall be "fire alarm red" unless otherwise noted. Gongs of bells to be dull black unless otherwise noted. Stations in main lobbies shall be of cast bronze. Bells in main lobby shall be installed behind flush bronze grille, design to be selected and approved by the Architect.

7.17 Siren Systems

- A. General alarm siren, pushbutton control.
- B. General alarm siren, remote control. (1) Momentary. (2) Start-stop.
- C. General alarm siren, up and down scale, pull lever stations.
- D. General alarm siren, up and down scale, pushbutton switches.
- E. General alarm siren, up and down scale, with program clock.
- F. Code alarm siren, pushbutton control.
- G. Code alarm siren, remote control.
- H. Code alarm siren, central station transmitter.
- I. Code alarm siren, pull lever stations.

General

Furnish and install a (trade name and/or number) siren system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications, and left in first class operating condition.

Operation

A. General alarm siren, pushbutton control: At each location in the interior (or exterior) of the buildings where shown on plans there shall be a pushbutton switch. At each location where shown there shall be a general alarm siren. Depressing the pushbutton switch shall cause all sirens to operate continuously until the pressure is released on the pushbutton de-energizing the sirens.

B. General alarm siren, remote control: At each location where shown on plans there shall be a heavy duty pushbutton switch having (1) momentary contacts, (2) start-stop contacts. (1, 2) At location near siren there shall be a remote control switch. On roof where shown there shall be a general alarm siren. Depressing (1) the pushbutton shall maintain contact and cause the siren to operate continuously as long as pressure is applied. (2) the "start" button shall make contact and cause the siren to operate continuously until the "stop" button is depressed.

C. General alarm siren, up and down scale, pull lever stations: At each

115

Dc. Install where shown adjacent to the remote control switch a test button to be of the same type used in operating the siren.

Dd. Install where shown on plans a predetermined general alarm control unit consisting of an automatic timing movement and contactors in surface steel cabinet. Movement to be driven by a synchronous motor.

De. (Same as Bc.)

Ea. Install where shown a surface mounting heavy duty push-button switch of the "start-stop" type, enclosed in steel housing as provided by the manufacturer.

Eb. (Same as Bb.)

Ec. (Same as Dd.)

Ed. Install adjacent to the general alarm control unit a program clock of the five minute interval type, arranged with switch for silencing signal on Sundays and Holidays, and provided with test switch. Clock shall be operated by a self-starting synchronous motor, all enclosed in surface steel cabinet.

Ee. (Same as Bc.)

Fa. (Same as Aa.)

Fb. Install where shown on plans a one-third horsepower code alarm siren with adjustable mounting bracket and enclosed in a weatherproof housing, for operation on voltage and current available from the lighting supply.

Ga. (Same as Aa.)

Gb. (Same as Bb.)

Gc. Install on roof where shown a vertical type code alarm siren (two, three, five or seven and one-half horsepower as required) in weatherproof housing and complete with mounting supports, for operation on the proper voltage, current and frequency as recommended by the manufacturer.

Ha. Install where shown an accelerated central station transmitter consisting of a pull lever wound clockwork movement and a set of different interchangeable code wheels, which may be operated for two, three or four rounds as selected. Entire equipment to be enclosed in a surface mounted cabinet.

Hb. (Same as Bb.)

Hc. (Same as Gc.)

Ia. (Same as Ca.)

Ib. (Same as Bb.)

Ic. (Same as Gc.)

Ja. (Same as Aa.)

7.18 Public Telephone System

General

Furnish and install a conduit system for the public telephones as recommended and specified by the (name of local public telephone company) and described in these specifications and indicated on wiring plans.

Terminal Strip Cabinets

These cabinets shall be supplied and installed as required by the telephone company less terminal strips, however, they must be of proper size and have the proper gutter requirements.

7.19 Watchman's Tour Systems

A. Compulsory recorded tour.

B. Supervisory proprietary tour.

C. Central station.

General

Furnish and install a (trade name and/or number) watchman's tour system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications and left in first class operating condition.

Operation

A. Compulsory recorded tour system: At each location shown on plans there shall be a watchman's tour station. The first and last stations of each tour shall be electrical transmitters, all others between these two points are to be of the mechanical type. In superintendent's office install a paper tape printing recorder. Operation of the first electrical transmitter by inserting a special key shall cause to be printed in the recorder a designation for the "Start" of the tour. The key shall be so arranged that it will only operate in sequence from one station to the other, and shall be "set up" when inserted in one station to fit into the following station. The key when inserted in the last electrical transmitter shall record the "Finish" of the tour.

B. Supervisory proprietary tour system: At each location shown on plans there shall be a watchman's tour station. All stations are provided with a jack and pilot lamp. In guard's room

install a supervisory desk with recording and communication facilities. A handpiece with cord and heavy duty plug, dummy plug and leather carrying case shall be provided for each guard. The guard on each tour normally inserts the dummy plug in every station consecutively. This causes an indicating drop on an annunciator at the desk to come into view for each station, and also records the time of the visit on a chart. The guard may converse with the chief guard from every outlying station by connecting the handpiece. The chief guard may call a guard on a tour by operating a tour control key at the desk which lights all pilot lamps on the stations for that tour. The guard answers the chief guard by connecting the handpiece.

C. Central station system: (Similar to system A, except that the recording is transmitted to a central station operating company.)

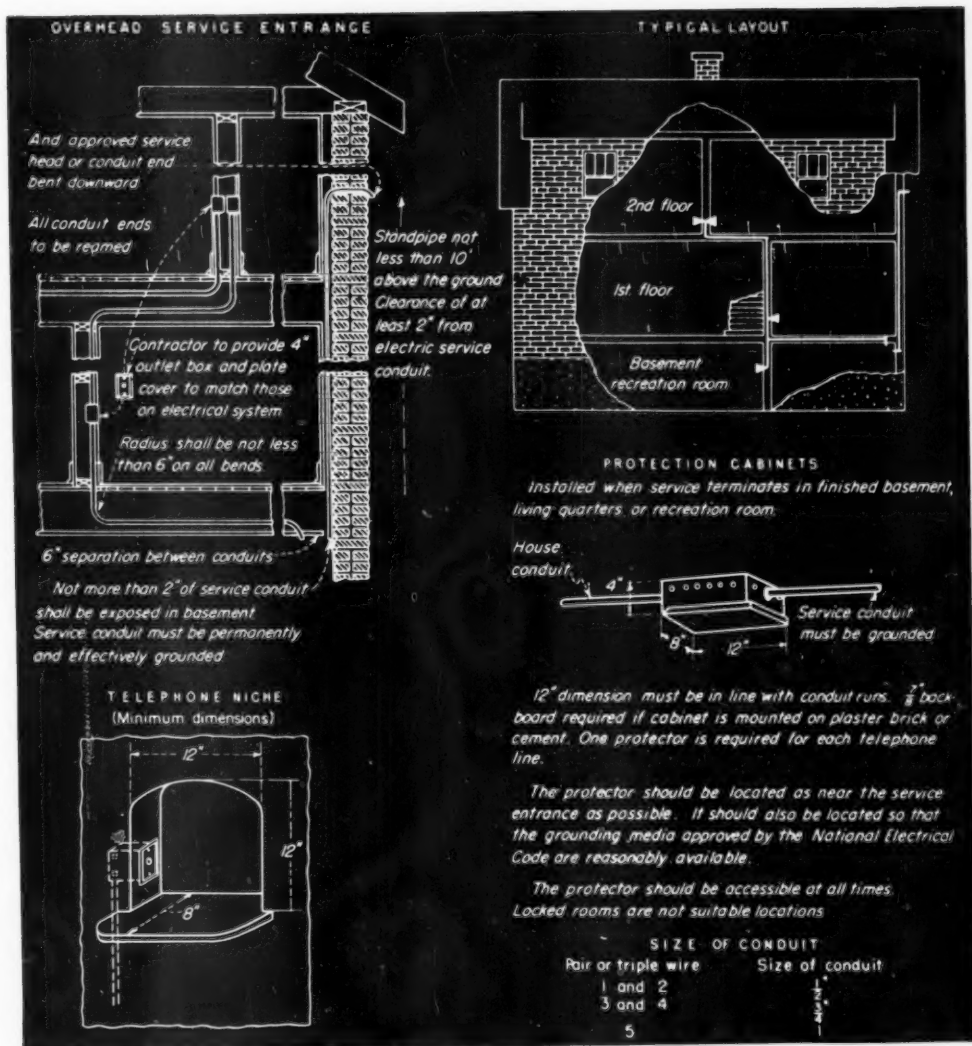
Equipment

Aa. Install at the first and last stations in the tour an electrically operated transmitter consisting of clock mechanism and contact springs mounted behind faceplate having an opening for insertion of tour key. At all other locations install an intermediate mechanical station. Provide one tour key for each guard or tour.

Ab. Install in superintendent's office a metal case tour recorder with synchronous motor driven clock and magnetically operated printing mechanism complete with paper tape and rollers. Recording shall indicate "start" or "finish" of tour, and time of visit. Each tour shall have separate terminal connections.

Ba. At each location shown install a watchman's station consisting of a cast metal plate having mounted thereon a heavy duty jack and a bullseye with lamp and receptacle complete with backbox.

Bb. In guard room install a metal desk with turret having mounted thereon a central panel with an electrical record annunciator equipped with—drops (name number based on one drop for each station on a tour), route control keys and pilots, loudspeaker and handpiece with cord and plug. The left hand panel shall contain the synchronous motor



Typical telephone raceways required in residences.

driven chart recorder. The right hand panel shall contain the charging meter and control equipment for the battery. The lower rear section shall contain all terminal strips for the circuit wiring.

Bc. In machine room in basement install a complete storage battery and rack with dry plate rectifier charger arranged for trickle and booster charging. The voltage and the size of the battery cells shall be as recommended by the manufacturer of the system.

Ca. (Same as paragraph Aa.)

Cb. Install in superintendent's office a metal cabinet with hinged door and equipped with lock and keys. This cabinet shall contain the central station transmitter complete with control and test equipment and terminal strips to extend wiring to exterior wiring.

Terminal Strip Cabinets

Furnish and install where shown on plans, flush steel cabinets with hinged doors equipped with lock

and keys. The terminal strips shall have sufficient pairs of terminals for all conductors plus 10% spares. Terminal strips must be mounted on a sheet of insulating material.

Operating Current

The system shall operate from (A) 115 volts 60 cycle ac, (B) storage battery with voltage and current output in accordance with the manufacturer's recommendation, (C) central station operating company's source of current, (A, B)

derived from separate circuit from nearest lighting panel.

Wiring

All wiring shall be run in approved conduit in the same manner as for the lighting system. The wires for the signal circuits shall be color-coded and rubber covered. (A) 2 No. 14 B & S gauge, (B) Section and common signal wires No. 16 B & S gauge with telephone wires twisted No. 19 or No. 22 B & S gauge, (C) wiring as recommended by the central station operating company.

7.21 Electric Clock Systems

- A. Synchronous, single motored clocks, no central control.
- B. Synchronous, single motored clocks, central control.
- C. Synchronous, dual motored clocks, central control (1) Manual (2) Automatic.
- D. Synchronous, dual motored clocks, central control, hourly correction.
- E. Master and secondary clocks.
- F. Electronic controlled clocks.

General

Furnish and install an (trade name and/or number) electric clock system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications and left in first class operating condition.

Operation

A. Synchronous single motored clocks, no central control system: At each location where shown there shall be a single synchronous motored clock, connected on a separate circuit (or plugged into hanger receptacle) with not more than 25 connected thereto. All clocks shall operate individually from the lighting circuit. Clocks shall be provided with a manual reset device.

B. Synchronous single motored clocks, central control system: At each location where shown there shall be a single synchronous motored clock. In supervisor's office there shall be an automatic control panel which shall correct the time on all clocks in the event of an interruption of current.

Normally the clock operates from the motor at the standard speed. When an interruption has occurred the control panel shall automatically connect the clock motors to a motor-generator set having an output of double the frequency and cause the clock motors to speed up upon the return of the current supply. When the correct time has been established the generator is automatically disconnected and the clock motors operate at their normal speed. All clocks in the system shall be connected in multiple and the wires shall terminate in the control panel.

C. Synchronous dual motored clocks, central control system: At each location where shown there shall be a synchronous motored clock with two motors. In supervisor's office there shall be (1) a manual control unit, (2) an automatic control unit, (1,2) which shall correct the time on all clocks simultaneously, in the event of an interruption of current. Normally the clock movements operate on the standard speed motor. When clocks are "slow" the high speed motor advances the clocks to the correct time. When the correct time has been established, the normal speed motors are returned to the circuit.

D. Synchronous dual motored clocks, central control, hourly correction system: At each location where shown there shall be a dual synchronous motored clock. In supervisor's office there shall be an automatic clock control panel, which shall correct the time hourly. Normally the clock movement operates from one motor at normal standard speed. When any clock is "fast" it is held at a designated point until all other clocks advance to the same time, then all clocks advance in unison. When any clock is "slow" it is speeded up with a second motor until it reaches a designated point and then it advances with all other clocks which were held immobile.

E. Master and secondary clock systems: At each location where shown there shall be a secondary minute impulse clock. In supervisor's office there shall be a master clock which shall transmit electrical impulses once each minute to all secondary clocks, time stamps and card time recorders and advance them one minute at a time under normal conditions. The master clock shall correct the secondary clocks once each hour at some pre-determined point, whether "fast" or "slow".

F. Electronic controlled clock system: At each location where shown there shall be an electronic controlled secondary clock. In supervisor's office there shall be an electronic master clock which shall transmit radio impulses once each hour to all secondary clocks. Upon receipt of the hourly supervisory impulse, each secondary clock initiates its own self-corrective cycle, whether "fast" or "slow". The high frequency current shall be transmitted from the master clock to fixed frequency electronic receivers in the secondary clocks over direct wire connections fully metallic circuit. (The secondary clocks may also be connected at any outlet if desired.)

Equipment

Aa. Install in each room a flush (or surface) synchronous motored ac clock with single motor having a 12-inch (or 10- or 15-inch) dial in round spun metal case with convex cover glass, complete with outlet box (or hanger plate outlet with cord and plug). In corridors install a double face wall bracket mounting (or ceiling suspended) clock with 15 inch (or 18 inch) dials in round spun metal case having metal bracket wall supports (or chain supports) with convex cover glasses complete with backbox. Clocks shall be equipped with manual reset device.

Ba. (Similar to paragraph Aa. except that cords and plugs are omitted).

Bb. In supervisor's office install an automatic control panel complete with necessary relays, control and timing equipment for connecting and disconnecting the double frequency generator.

Bc. In machine room install a double frequency motor-generator mounted on shock absorbing base and fastened to floor. Motor shall operate from 115 volts 60 cycle ac, generator shall have an output of 115 volts 120 cycles ac and shall have sufficient capacity to supply current to the entire system.

Ca. Install in each room a flush (or surface) synchronous motored ac clock with two motors having a 12-inch (or 10 or 15 inch) dial in round spun metal case with convex cover glass, complete with backbox. In corridors install a double face wall bracket mounting (or ceiling suspended) clock with 15-

inch (or 18 inch) dials in round spun metal case having metal brackets wall supports (or chain supports) with convex cover glasses complete with backbox.

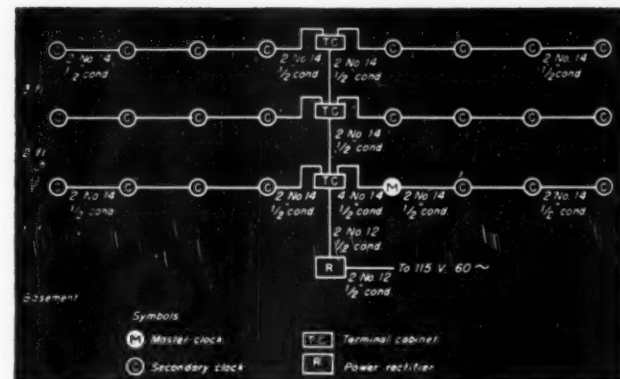
Cb. In supervisor's office install (1) a manual control plate having mounted thereon two tumbler switches, one for control of normal speed motors and one for control of high speed motors, (2) an automatic control panel in flush (or surface) steel cabinet with hinged door equipped with lock and keys. The panel shall contain all control equipment for operating the normal and high speed clock motors.

Da. Install in each room a flush (or surface) synchronous motored ac clock with dual motor and special traingear for changing speed of same. The size of the dial shall be 12 inches (or 10 or 15 inches) and shall be mounted in a round spun metal case with convex cover glass, complete with backbox. In corridors install a double face wall bracket mounting (or ceiling suspended clock with 15-inch (or 18 inch) dials in round spun metal case having metal bracket wall supports (or chain supports) with convex cover glasses.

Db. In supervisor's office install an automatic clock control panel consisting of selector, relays, timer, rectifier, transformer and terminals enclosed in surface steel cabinet with hinged door equipped with lock and keys.

Ea. Install in each room a flush (or surface) magnet operated secondary clock with 12 inch (or 10 or 15 inch) dial, in round spun metal case with convex cover glass complete with backbox. In corridors install a double face wall bracket mounting (or ceiling suspended) clocks with 15-inch (or 18 inch) dial in round spun metal case with metal bracket supports (or chain supports) with convex cover glasses, complete with backbox.

Eb. In supervisor's office install a master clock with minute impulse 60 beat Graham dead beat escapement movement magnet (or motor) wound, with mercurial (invar or bob) pendulum to keep correct time within 10 seconds (bob 30 seconds) per month, 12 inch dial, relays for each secondary clock circuit of 25, with hourly correction equipment, all enclosed in surface (or flush) wood (or metal) case.



Riser layout master and secondary clock system.

Ec. In machine room install a stable voltage rectifier having an output of 24 volts dc with current sufficient to operate all clocks on the system.

Fa. Install in each room a flush (or surface) electronic controlled secondary clock complete with receiving and amplifying equipment and synchronous motor movement. Clocks shall have 12 inch (or 15 inch) dials, in metal cases with convex cover glasses complete with backboxes. In corridors install double face bracket mounting (or ceiling suspended) clocks with 15 inch (or 18 inch) dials in metal cases with metal bracket supports (or chain supports) with convex cover glasses.

Fb. In supervisor's office install a master electronic clock with high-frequency transmitting equipment and selective corrective apparatus to regulate secondary clocks and a synchronous motor for operating the traingear of the clock. This shall be enclosed in a metal case with convex cover glass and 12 inch (or 18 inch) dial.

Terminal Strip Cabinets

Furnish and install where shown on plans, flush steel cabinets with hinged doors equipped with lock and keys. The terminal strips shall have sufficient pairs of terminals for all conductors plus 10% spares.

Operating Current

The system shall operate (A,B, C,D,F) directly from 115 volts 60 cycle ac (E) a stable voltage recti-

fier power supply having an output of 24 volts dc, (A,B,C,D,E,F) derived from a separate circuit from the nearest lighting panel. Circuit switch shall be appropriately marked or held to prevent accidental operation.

Wiring

All wiring shall be run in approved conduit in the same manner as for the lighting system. The wiring to all clocks shall be No. 14 B & S gauge. (A,B,E,F) Two wires are required for the circuits. (CD) Three wires are required.

Finish

All wood finishes of master clocks shall match surrounding woodwork. Metal cabinets shall be standard finish (or have prime coat). Clock cases shall be standard finish (or be finished as directed by the Architect).

7.22 Program Signal Systems

- Synchronous, single circuit, 5 minute interval.
- Synchronous, single circuit, 1 minute interval.
- Synchronous, multi-circuit, 1 minute interval.
- Minute impulse, single and multi-circuit, 1 minute interval.
- Electronic, single and multi-circuit, 1 minute interval.

General

Furnish and install an (trade name and/or number) electric motored program instrument as

manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications and left in first class operating condition.

Operation

A. Synchronous, single circuit, 5 minute interval: In office where shown there shall be a self-starting synchronous motored program instrument, connected and supplied with current from a separate circuit from the nearest lighting panel. The instrument shall be of the metal disc type and shall control a single circuit of audible signals on any five minute interval over a 24-hour period. A calendar device shall be provided to automatically silence the signal circuit on Saturdays and Sundays. A manually operated switch shall be provided on exterior of cabinet to silence the signals at any time as desired.

B. Synchronous, single circuit, 1 minute interval: In office where shown there shall be a self-starting synchronous motored program instrument, connected and supplied with current from a separate circuit from the nearest lighting panel. This instrument shall be of the metal drum or disc type and shall control a single circuit of audible signals on any one minute interval over a 24-hour period. A calendar device shall be provided to automatically silence the signal circuit during any desired two-hour period. A manually operated switch shall be provided to operate the signals manually as desired. The length of the signal shall be controlled by means of a duration contact.

C. Synchronous, multi-circuit, 1 minute interval: In office where shown there shall be a self-starting synchronous motored program instrument, connected and supplied with current from a separate circuit from the nearest lighting panel. This instrument shall be of the metal drum or disc type and shall control two (three, four, five or six) circuits of audible signals on any one minute interval over a 24-hour period. A calendar device shall be provided to automatically silence the signal circuits during any desired two-hour period. A manually operated switch shall be provided to silence each

signal circuit as desired. A pushbutton switch shall be provided to operate each signal circuit as desired. Two duration contacts shall be included for regulating the length of the signals, one to control all interior signals and one to control all exterior signals. The front of the cabinet shall have a timepiece fitted into same.

D. Minute impulse, single and multi-circuit, 1 minute interval: In office where shown there shall be a minute impulse type of program instrument installed in same cabinet with the master clock (or mounted adjacent thereto) and connected and supplied with current now energizing master and secondary clock system. The instrument shall be of the metal disc type and shall control (one, two, three, four, five or six) circuits of audible signals on any one minute interval over a 24-hour period. A calendar device shall be provided to automatically silence the signal circuit (or circuits) during any desired six-hour period. A manually operated switch shall be provided for each signal circuit for silencing as desired. A pushbutton switch shall be furnished for each signal circuit for manual operation as desired. Duration contacts shall be furnished (one for single circuit, two for multi-circuit) for control of time on signals.

E. Electronic, single and multi-circuit, 1 minute interval: In office where shown there shall be an electronic type of program instrument installed in same cabinet with electronic master clock and connected and supplied with current now energizing the master clock. The instrument shall be of the metal type and shall control one (two, three or four) circuits of audible signals, wired or unwired, on frequencies assigned on any one minute interval over a 24-hour period. A calendar device shall be provided to automatically silence the signal circuits during any desired six-hour period. A manually operated switch shall be provided for each signal circuit. A pushbutton switch shall be furnished for each signal circuit for manual operation as desired. Duration contacts shall be furnished (one for single circuit, two for multi-circuit) for control of time on signals.

Equipment

Aa. Install where shown a surface mounted, synchronous motored ac program instrument. This

shall consist of a metal disc with metal plugs for setting up the time for operating a single circuit of audible signals on any five minute interval. The calendar device shall be associated with the program disc for silencing the signal circuit. The signal circuit contacts shall have a capacity of at least five amperes. A circuit switch shall be contained within the case for silencing the audible signals. Front of case shall be fitted with a glass panel for inspection of the program disc.

Ab. Install where shown a vibrating bell (four, six or ten inches) or horn (projector or projectorless) or chime (single or double note) or buzzer and connect in multiple directly to the program instrument.

Ba. Install where shown a flush (or surface) mounted synchronous motored ac program instrument. This shall consist of a metal drum or disc with metal plugs for setting up the time for operating a single circuit of audible signals on any minute interval. The calendar device shall be associated with the program device for silencing the signal circuit. The enclosed equipment shall be complete with a duration contact, circuit relay and reset switch. The exterior equipment shall consist of a manual pushbutton switch and a circuit silencing switch.

Bb. (Same as paragraph Ab.)

Ca. Install where shown a flush (or surface) mounted synchronous motored ac program instrument. This shall consist of a metal drum or disc with metal plugs for setting up the time for operating two (three, four, five or six) circuits of audible signals on any minute interval. The calendar device shall be furnished with plugs for changing the operating periods and to silence the signal circuits on any two-hour periods. The enclosed equipment shall be complete with two duration contacts, two (three, four, five or six) circuit relays (selected as to number of program circuits) reset switch and disconnect switch. The exterior equipment shall consist of two (three, four, five or six) circuit pushbutton switches and the same number of circuit disconnect switches, with a timepiece set into hinged door.

Cb. (Same as paragraph Ab.)

Da. Install where shown a flush (or surface) mounted magnetically operated program instrument for operation on same current supply as the minute impulse clock system. This shall consist of a metal disc with metal plugs or inserts for setting up the time for operating one (two, three, four, five or six) circuits of audible signals on any one minute interval. The calendar device shall be furnished with plugs or inserts for changing the operating periods, and to silence the signal circuits on any six-hour period. The enclosed equipment shall be complete with one (or two) duration contacts, one (two, three, four, five or six) circuit relays (selected as to number of program circuits) reset key for magnetic movement and a disconnect switch. The exterior equipment shall consist of one pushbutton switch for each signal circuit and a timepiece set into hinged door.

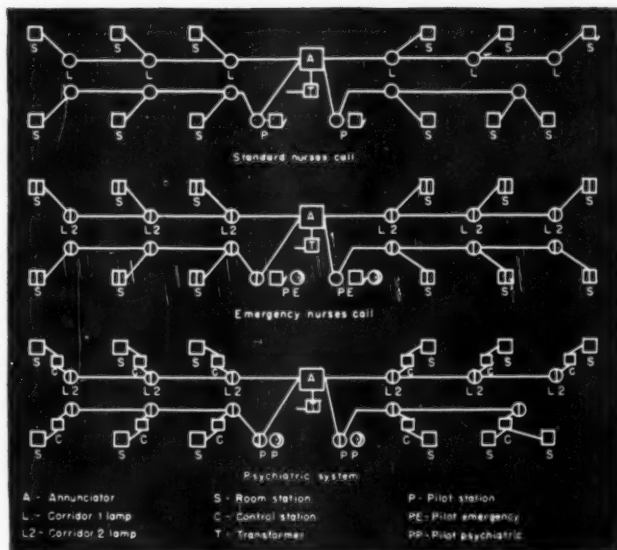
Db. (Same as paragraph Ab.)

Ea. Install where shown a flush (or surface) mounted electronic type of program instrument for operation on the electronic clock system. This shall consist of a metal program instrument with adjustment for setting up the time for operating one (two, three or four) circuits of audible signals on any one minute interval. A calendar device shall be associated with the program unit and arranged for changing the operating periods and to silence the signal circuits on six-hour periods. The enclosed equipment shall be complete with two duration contacts, two (three or four) circuit relays, reset switch and disconnect switch. The exterior equipment shall consist of one (two, three or four) circuit pushbutton switches with a timepiece set into hinged door.

Eb. Install where shown a vibrating bell (four-, six- or ten-inch) or buzzer for operation on a different frequency for each circuit and connect to program instrument.

Terminal Strip Cabinets

Furnish and install where shown on plans, flush steel cabinets with hinged doors equipped with lock and keys. The terminal strips shall have sufficient pairs of terminals for all conductors plus 10% spares.



Layout nurses' call system.

7.21 Nurses' Calling System

- A. Lamp annunciator. (1) Locking button. (2) Pull cord.
- B. Nurse-patient communication. (1) Portable speaker. (2) Wall speaker.
- C. Psychiatric.

General

Furnish and install a (trade name and/or number) nurses' calling system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system shall be wired and installed in accordance with the manufacturer's specifications, and left in first class operating condition.

Operation

A. Lamp annunciator system: At each bed there shall be a calling station having a (1) detachable plug, cord and locking button, (2) toggle switch with pull cord and pendant (1, 2). A patient desiring a nurse shall (1) press the locking button, (2) pull the cord, (1, 2) which causes a lamp signal to light at the following locations: over the patient's room door on corridor side, directional pilots at intersection of corridors, pilots or annunciators in diet kitchens and utility rooms, nurses' station and supervisory office. In addition, stations in wards

shall have bullseye lighted on calling station. Simultaneously there shall sound momentarily a buzzer in the pilot stations and annunciators except directional pilots. The buzzer may be sounded repeatedly by the patient if necessary. A cut-off switch shall be provided with each buzzer. All lamp signals shall remain lighted until the call is reset by the nurse at the bedside. (1) Removal of the plug accidentally or otherwise shall light the same lamp signals as if the patient had pressed the calling button, and shall cause the buzzer to sound continuously to signify that the station is out of service. To allow of removal of plugs when desired, the receptacle must also be provided with a device so that all signals may be cancelled with the plug removed. It shall be possible to replace plug with the switch in the "off" position.

B. Nurse-patient communication: At each single or double bed there shall be an extension of the plate on the nurses' call station which shall contain (1) facilities for a portable speaker-microphone, (1) screened flush speaker-microphone, (1, 2). A patient desiring a nurse shall (1) press the locking button, (2) pull the cord, (1, 2) which causes a lamp signal to light, and buzzers to operate at the same points as the regular calling system, except at the nurses' station annunciator

which shall be replaced by a nurses station control keyboard unit and a power unit with amplifier. The control keyboard shall be provided with two position switches for each pair of rooms, with individual lamp signals for each room, and a molded hand-phone for conversing with the patient. It shall not be possible for the nurse to listen in on any room for supervisory purposes without operating a pilot light on the patient's station. A switch shall be provided on each room speaker-microphone to insure privacy when desired.

C. Psychiatric system: At the entrance to each private room, ward and day room, there shall be a wall control station having a cylindrical lock switch. In the private rooms there shall be a wall station with pushbutton. In wards and day rooms there shall be two or more wall stations as shown. By inserting and turning a key in the lock of the corridor station an attendant shall cause a clear lamp to light at the following locations: over the patient's room door corridor side, pilots or annunciators in the diet kitchens and utility rooms, nurses' station and supervisor's office. An attendant may summon assistance by operating a button in the room stations, which shall cause to be lighted a red lamp at all points also equipped with clear lamps. In addition a bell shall ring in all pilot stations and annunciators. All signals, both bells and lamps shall remain "on" until assistance arrives and the wall control station is reset by means of a key.

Equipment

Aa. Install in all private rooms a nurses' calling station consisting of single gang metal wall plate with (1) receptacle mounted on a separate yoke and having a detachable five way plug with a single cord and molded locking button, (2) toggle switch having five contacts and single pull cord with pendant.

Ab. Install in all semi-private rooms where beds are not adjacent same type of stations specified for the private rooms. Where beds are adjacent provide stations with (1) single plug with two six-foot cords and two locking buttons, (2) double pull cords and pendants.

Ac. Install in all wards having three or more beds, stations similar to those specified for the pri-

vate and semi-private rooms, except that a bullseye complete with lamp and receptacle is to be added.

Ad. Install in all toilets, bathrooms and solariums a wall type cordless station on single gang metal plate.

Ae. Install on each open porch or balcony a station similar to that specified for the private rooms except that it shall be weatherproof and be provided with a screw-on cover to cover the receptacle, and a rubber gasket between the station plate and the wall, complete with a cord 15 feet long.

Af. Install in operating rooms explosion-proof calling stations, consisting of a special cast explosion-proof backbox and cover, with operating mechanism inside of the box. The station shall be operated by an exposed plunger on the front of the cover, so arranged that calls may be initiated or cancelled by the foot. Calls from the station shall sound all buzzers continuously in addition to lighting the lamps until the call is cancelled.

Ag. Install in the corridor over the door of each private room and ward, a dome type corridor lamp station. This station shall consist of a two gang metal plate having mounted thereon a glass or translucent plastic dome covering a candelabra base receptacle and lamp. The dome shall be hinged and fastened to the plate by a snap catch.

Ah. Install in the diet kitchens and utility rooms a pilot and buzzer station consisting of a three gang metal plate having mounted thereon a hinged glass or translucent plastic dome similar to the corridor lamp station with the addition of a buzzer and cut-off switch.

Ai. Install in the diet kitchens and utility rooms a bullseye pilot and buzzer station (use in lieu of dome type where sectional indications are desired) consisting of a metal plate having one bullseye indication for each ward on the floor and one common indication for all private rooms. In addition provide a concealed buzzer and a cut-off switch.

Aj. Install at the nurses' station on each floor a flush lamp annunciator with metal trim and hinged door with lock. There shall be contained therein the necessary

number of lamps to provide one indication for every private room, ward, solarium and isolated toilet on the floor or section. Annunciator at the floor supervisor's office is to be fully equipped for the entire floor. In addition provide a concealed buzzer with cut-off switch.

Ba. (Add to paragraphs Aa. and Ab.) For nurse-patient communication add a molded receptacle on same plate. In addition provide a speaker-microphone of the permanent magnet type (1) in acoustically treated portable cabinet with eight foot rubber cord and a plug, (2) behind an extended gridded plate. Privacy switch shall be mounted on (1) speaker cabinet, (2) speaker plate.

Bd. (Add to paragraph Ae.) For nurse-patient communication add to the wards' stations the same equipment as for the private room stations.

Bc. (Add to paragraph Aj.) For nurse - patient communication eliminate lamp annunciator and locate at nurses' station a control keyboard consisting of a portable desk unit containing a jewel light for each room station, three-position switching keys for each pair of stations, telephone handset on cradle with press-to-talk switch on handset or cabinet terminal strip connected to flexible cable attached to flush wall box with trim, amplifier, power supply unit and directory strip.

Ca. Install in corridor adjacent to private rooms, wards and day-room doors a wall control station consisting of a two gang metal plate with a multi-contact magnetic switch and cylindrical lock mounted on a separate yoke. The lock shall be master-keyed. Fastening screws to be tamper-proof.

Cb. Install inside of each private room a calling station consisting of a single gang metal plate with special momentary contact pushbutton mounted on a separate yoke. Wards and dayrooms to have two or more stations as shown on plans. Fastening screws to be tamper-proof.

Cc. Install in corridor over the door of each private room, ward and dayroom a dome type corridor lamp station. This station shall consist of a two gang metal plate having mounted thereon a glass or translucent plastic dome covering

two candelabra base receptacles and two lamps, one red and one clear. The dome shall be hinged and fastened to the plate by a snap catch.

Cd. Install in diet kitchens and utility rooms a pilot and bell station consisting of a metal plate having mounted thereon a hinged glass or translucent plastic dome covering two candelabra base receptacles and two lamps, one red and one clear together with an underdome bell.

Ce. Install in diet kitchens and utility rooms a bullseye pilot and bell station (to be used in lieu of the dome type where desired to have sectional indications instead of one lamp of each color as indications for an entire floor) consisting of a metal plate having two bullseyes, one red and one clear, for each ward and dayroom on the floor, and two similar common bullseyes for all private rooms, together with an underdome bell.

Cf. Install at the nurses' station on each floor a flush lamp annunciator with metal trim and hinged door with lock. There shall be contained therein the necessary number of red and clear lamps for each private room, ward and dayroom on the floor or section. In addition provide a concealed underdome bell.

Terminal Strip Cabinets

Furnish and install where shown on plans, flush steel cabinets with hinged doors equipped with lock and keys. The terminal strips shall have sufficient pairs of terminals for all conductors plus 10% spares. Terminal strips must be mounted on a sheet of insulating material. Terminal cabinet trim shall be installed true and finished with (specify type of primer or finish paint and color.)

Gang Plates

All nurses' calling system station plates shall be extended to include duplex convenience receptacles, telephone jacks, radio jacks and bedside night light. The outlet boxes shall enclose these outlets and must contain barriers to separate the 115 volt portions of the outlet and wiring from circuits, wiring and devices operating at a lower voltage.

SIGNAL SYSTEM CABLES

Rubber Covered

No. Cond.	No. 18-1/64" R*			No. 18-1/32" R			No. 16-1/64" R*			No. 16-1/32" R		
	Over. Diam.	Ap-prox. Area Sq. In.	Con-duit Size	Over. Diam.	Ap-prox. Area Sq. In.	Con-duit Size	Over. Diam.	Ap-prox. Area Sq. In.	Con-duit Size	Over. Diam.	Ap-prox. Area Sq. In.	Con-duit Size
10	0.49	0.188	3/4"	0.61	0.292	1"	0.53	0.219	1"	0.65	0.330	1"
20	0.63	0.314	1"	0.80	0.503	1 1/4"	0.69	0.377	1 1/4"	0.85	0.565	1 1/4"
30	0.74	0.392	1 1/4"	0.94	0.691	1 1/2"	0.81	0.518	1 1/2"	1.01	0.802	1 1/2"
40	0.83	0.541	1 1/2"	1.06	0.880	2"	0.92	0.668	1 1/2"	1.14	1.021	2"
50	0.93	0.675	1 1/2"	1.18	1.094	2"	1.02	0.817	1 1/2"	1.27	1.254	2"
60	1.00	0.785	1 1/2"	1.28	1.288	2"	1.10	0.950	2"	1.38	1.492	2 1/2"
70	1.10	0.950	2"	1.41	1.563	2 1/2"	1.21	1.147	2"	1.53	1.838	2 1/2"
80	1.15	1.037	2"	1.48	1.720	2 1/2"	1.27	1.254	2"	1.60	2.011	3"
90	1.21	1.147	2"	1.54	1.861	2 1/2"	1.32	1.367	2 1/2"	1.67	2.191	3"
100	1.28	1.288	2"	1.66	2.168	3"	1.41	1.563	2 1/2"	1.79	2.513	3"
125	1.40	1.539	2 1/2"	1.82	2.592	3"	1.56	1.909	2 1/2"	1.96	2.974	3 1/2"
150	1.54	1.861	2 1/2"	1.99	3.110	3 1/2"	1.70	2.260	3"	2.15	3.628	3 1/2"
175	1.66	2.168	3"	2.14	3.596	3 1/2"	1.83	2.631	3"	2.31	4.163	4"
200	1.77	2.458	3"	2.28	4.084	4"	1.95	2.984	3 1/2"	2.47	4.791	4"

* Approved by special permission only.

GROUPED SINGLE CONDUCTORS

Size AWG	Insulation RF 32, R, RH, RW*		Insulation TF, T, TW, RU*		Insulation RF-64**		Maximum Number Conductors in Conduit											
	Over. Diam.	Ap-prox. Area Sq. In.	Over. Diam.	Ap-prox. Area Sq. In.	Over. Diam.	Ap-prox. Area Sq. In.	3/8 in. Int. Area Sq. In.	1/2 in. Int. Area Sq. In.	5/8 in. Int. Area Sq. In.	3/4 in. Int. Area Sq. In.	7/8 in. Int. Area Sq. In.	1 in. Int. Area Sq. In.	1 1/8 in. Int. Area Sq. In.	1 1/4 in. Int. Area Sq. In.	1 1/2 in. Int. Area Sq. In.	1 3/4 in. Int. Area Sq. In.	2 in. Int. Area Sq. In.	2 1/2 in. Int. Area Sq. In.
18	.146	.0167	.106	.0088			7	12	20	35	49	80	115	176				
16	.158	.0196	.118	.0109	.100	.0079	14	24	42	73	100	165	236	364				
14	.171	.0230	.131	.0135	.113	.0100	12	19	33	58	79	131	186	287				
12	.188	.0278	.148	.0172			4	6	10	18	25	40	59	90				
10	.242	.0460	.168	.0224			3	5	8	15	21	35	50	77				
8	.311	.0760	.228	.0408			2	4	7	13	17	29	41	64				
6	.397	.1238	.323	.0819			1	3	4	7	10	17	25	38				

Combination of Conductors

*			**		
1—No. 14 Equal to	1—No. 18 or 1 No. 16	3—No. 18 or 2 No. 16	1—No. 14 Equal to	1—No. 18 or 1 No. 16	3—No. 18 or 2 No. 16
2—"	2—"	5—"	2—"	2—"	5—"
3—"	3—"	8—"	3—"	3—"	8—"
1—12	1—"	1—"	1—12	1—"	1—"
2—"	2—"	2—"	2—"	2—"	2—"
3—"	3—"	3—"	3—"	3—"	3—"

*In accordance with NEC.
**Approved by special permission.

†Above sizes apply to straight runs or with nominal offsets equivalent to not more than two quarter-bends

PAGING SYSTEM CABLES

No. Cond.	No. 14-3/64" R			No. 12-3/64" R			No. 14-3/64" RL			No. 12-3/64" RL		
	Over. Diam.	Ap-prox. Area Sq. In.	Con-duit Size	Over. Diam.	Ap-prox. Area Sq. In.	Con-duit Size	Over. Diam.	Ap-prox. Area Sq. In.	Thick Lead	Over. Diam.	Ap-prox. Area Sq. In.	Thick Cond. Lead Size
12	0.84	0.554	1 1/2"	0.94	0.680	1 1/2"	0.97	0.738	5/64"	1 1/2"	1.05	0.864 5/64" 2"
20	1.10	0.950	2"	1.19	1.112	2"	1.20	1.130	5/64"	2"	1.32	1.367 3/32" 2 1/2"
24	1.21	1.147	2"	1.31	1.348	2"	1.35	1.420	5/64"	2 1/2"	1.45	1.649 3/32" 2 1/2"

SIGNAL SYSTEM CABLES

Rubber and Lead

No. 18—1 64" RL*				No. 18—1 32" RL				No. 16—1 64" RL*				No. 16—1 32" RL			
Over Diam.	Approx. Area Sq. In.	Thick Lead	Conduit Size	Over Diam.	Approx. Area Sq. In.	Thick Lead	Conduit Size	Over Diam.	Approx. Area Sq. In.	Thick Lead	Conduit Size	Over Diam.	Approx. Area Sq. In.	Thick Lead	Conduit Size
0.56	0.243	4 64"	1"	0.69	0.377	4 64"	1 1/4"	0.61	0.292	4 64"	1"	0.73	0.416	4 64"	1 1/4"
0.70	0.385	4 64"	1 1/4"	0.90	0.636	5 64"	1 1/2"	0.76	0.454	4 64"	1 1/4"	0.96	0.723	5 64"	1 1/2"
0.82	0.528	4 64"	1 1/4"	1.05	0.864	5 64"	2"	0.92	0.665	5 64"	1 1/2"	1.12	0.985	5 64"	2"
0.94	0.680	5 64"	1 1/2"	1.17	1.076	5 64"	2"	1.02	0.817	5 64"	2"	1.28	1.288	6 64"	2"
1.03	0.833	5 64"	2"	1.32	1.367	6 64"	2 1/2"	1.12	0.985	5 64"	2"	1.41	1.563	6 64"	2 1/2"
1.10	0.950	5 64"	2"	1.41	1.563	6 64"	2 1/2"	1.20	1.130	5 64"	2"	1.51	1.791	6 64"	2 1/2"
1.21	1.147	5 64"	2"	1.55	1.885	6 64"	2 1/2"	1.35	1.413	6 64"	2 1/2"	1.66	2.168	6 64"	3"
1.29	1.304	6 64"	2"	1.61	2.035	6 64"	3"	1.40	1.539	6 64"	2 1/2"	1.76	2.435	7 64"	3"
1.33	1.390	6 64"	2 1/2"	1.68	2.199	6 64"	3"	1.46	1.673	6 64"	2 1/2"	1.83	2.631	7 64"	3"
1.42	1.571	6 64"	2 1/2"	1.82	2.592	7 64"	3"	1.55	1.885	6 64"	2 1/2"	1.95	2.985	7 64"	3 1/2"
1.54	1.885	6 64"	2 1/2"	1.98	3.063	7 64"	3 1/2"	1.69	2.246	6 64"	3"	2.12	3.526	7 64"	3 1/2"
1.68	2.199	6 64"	3"	2.15	3.628	7 64"	3 1/2"	1.86	2.717	7 64"	3"	2.34	4.304	8 64"	4"
1.82	2.592	7 64"	3"	2.33	4.265	8 64"	4"	1.99	3.110	7 64"	3 1/2"	2.50	4.909	8 64"	4"
1.93	2.906	7 64"	3"	2.47	4.791	8 64"	4"	2.11	3.495	7 64"	3 1/2"	2.66	5.553	8 64"	4 1/2"

* Approved by special permission only.

Signal and Communication Wiring Data

Wire sizes, dimensions and raceway data for types of conductors commonly used on signal, alarm and communication systems. Systems operating at substantial voltages and currents derived from power or lighting circuits are subject to code rules. On low voltage circuits line drop may also become a critically important consideration.

SINGLE TELEPHONE CABLE

Single No. 22 & 4 Single No. 18					
No. Cond.	Braided			Leaded	
	Over Diam.	Approx. Area Sq. In.	Cond. Size	Over Diam.	Approx. Area Sq. In.
6	0.26	0.053	1/2"	0.30	0.071
11	0.28	0.061	1/2"	0.33	0.086
16	0.31	0.075	1/2"	0.36	0.102
26	0.36	0.102	1/2"	0.40	0.126
35	0.40	0.126	1/2"	0.45	0.159
45	0.44	0.152	1/2"	0.48	0.181
55	0.46	0.165	1/2"	0.51	0.204
65	0.51	0.204	1/2"	0.55	0.236
75	0.53	0.219	1"	0.59	0.255
85	0.55	0.236	1"	0.60	0.283
100	0.60	0.283	1"	0.64	0.322

PAIR TELEPHONE CABLE

No. Pairs	Pairs No. 22 & 2 Pairs No. 18						Pairs No. 22 Only					
	Braided			Leaded			Braided			Leaded		
	Over Diam.	Approx. Area Sq. In.	Cond. Size	Over Diam.	Approx. Area Sq. In.	Cond. Size	Over Diam.	Approx. Area Sq. In.	Cond. Size	Over Diam.	Approx. Area Sq. In.	Cond. Size
6	0.36	0.102	1/2"	0.45	0.159	3/4"	0.29	0.066	1/2"	0.33	0.086	1/2"
12	0.41	0.132	3/4"	0.50	0.196	3/4"	0.38	0.133	1/2"	0.42	0.139	3/4"
16	0.50	0.196	3/4"	0.59	0.273	1"	0.42	0.139	3/4"	0.47	0.174	3/4"
22	0.57	0.255	1"	0.66	0.342	1"	0.49	0.188	3/4"	0.53	0.220	1"
32	0.62	0.302	1"	0.71	0.396	1 1/4"	0.57	0.253	1"	0.61	0.292	1"
41	0.74	0.430	1 1/4"	0.85	0.567	1 1/4"	0.61	0.292	1"	0.66	0.342	1"
51	0.88	0.608	1 1/2"	0.97	0.739	1 1/2"	0.70	0.385	1 1/4"	0.76	0.454	1 1/4"
65	0.92	0.665	1 1/2"	1.01	0.802	2"	0.76	0.454	1 1/4"	0.83	0.541	1 1/4"
75	0.95	0.709	1 1/2"	1.03	0.833	2"	0.82	0.528	1 1/4"	0.89	0.622	1 1/2"
85	0.98	0.754	1 1/2"	1.07	0.899	2"	0.86	0.581	1 1/4"	0.93	0.679	1 1/2"
100	1.08	0.916	2"	1.16	1.057	2"	0.94	0.694	1 1/2"	1.01	0.802	1 1/2"
125	1.18	1.094	2"	1.26	1.247	2"	1.01	0.802	1 1/2"	1.08	0.916	2"
150	1.27	1.254	2"	1.34	1.410	2 1/2"	1.12	0.985	2"	1.18	1.094	2"
175	1.37	1.474	2 1/2"	1.44	1.624	2 1/2"	1.18	1.094	2"	1.25	1.227	2"
200	1.45	1.649	2 1/2"	1.57	1.938	3"	1.27	1.254	2"	1.34	1.410	2 1/2"

DUPLEX & TRIPLEX

Size AWG	Insulation Rubber Braid		Maximum Conductors in Conduit							
	Over Diam.	Approx. Area Sq. In.	1/2 in. Int. Area 30 Sq. In.	3/4 in. Int. Area 53 Sq. In.	1 in. Int. Area 86 Sq. In.	1 1/4 in. Int. Area 150 Sq. In.	1 1/2 in. Int. Area 204 Sq. In.	2 in. Int. Area 336 Sq. In.	2 1/2 in. Int. Area 504 Sq. In.	3 in. Int. Area 672 Sq. In.
22"	20	.031	6	12	20	36	50	84		
22"	22	.038	9	15	24	45	60	102		
19"	24	.045	4	8	14	24	34	68		
19"	26	.053	6	9	18	33	45	75		

Note: * 2 Wire twisted.
† 3 Wire twisted.

8.1 Lighting

The lighting in a well planned lighting system is functional, and is also an actual part of the architectural and decorative treatment in most structures. Thus the lighting must be planned carefully, and all luminaires, light source types and sizes, and lighting equipment and devices must be judiciously selected to accomplish the desired lighting effects and lighting results as planned. Because of the scope of modern lighting practice and of the wide variety of light sources and lighting equipments available, the success of the final installation requires that all light sources and lighting equipment be provided and installed exactly as selected. To insure that this is done the designer should prepare a specific and detailed lighting specification complete with lighting plans and detail drawings.

Lighting equipment is normally classified under two broad headings: 1) Luminaires—individual lighting fixtures or lighting units, reflectors, etc.; and 2) Lighting Equipment—components and lighting devices, such as wiring channels, cove lighting, diffusing panels and louvers, etc., other than luminaires.

All luminaires, for fluorescent, incandescent or mercury vapor light sources, may be classified under one of five basic types based on their light distribution characteristics: 1) direct—D; 2) semi-direct—SD; 3) general diffuse or direct-indirect—G; 4) semi-indirect—SI; and 5) indirect—I. Standard specification paragraphs for fluorescent luminaires of these five types are given below (Section 8.22), and similar specification paragraphs can be prepared easily by the specification writer for luminaires of each of these five types using either incandescent or mercury vapor light sources. Standard specification paragraphs for Type D industrial reflector units for all three light sources are also given below (Section 8.31) covering the usual reflector type units normally used for industrial lighting purposes.


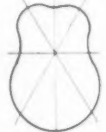
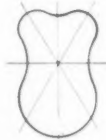

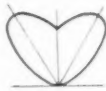
Lighting equipment other than luminaires varies so widely in types and application that no effort is made here to provide standard specification paragraphs for this type of equipment. Where such equipment is specified, for example, in cove lighting or special luminaires, the specifier should detail

the equipment on the drawings and prepare special specification paragraphs which describe the equipment in detail.

Luminaires of the five basic types vary widely in quality, design and mechanical features, materials, metal

thicknesses, brightnesses, finishes, etc. For this reason, it is desirable that the specifier indicate specifically and in detail the exact luminaires selected for each area of a lighting project. This may be done under any one of the following methods:

LUMINAIRE CLASSIFICATION

Light Distribution	System	Upward Component	Downward Component	Type or Symbol
	Direct	0-10%	90-100%	D.
	Semi-Direct	10-40%	60-90%	SD.
	General Diffuse or Direct-Indirect	40-60%	40-60%	G.
	Semi-Indirect	60-90%	10-40%	SI.
	Indirect	90-100%	0-10%	I.

RECOMMENDED LEVELS OF ILLUMINATION AND WIRING CAPACITIES

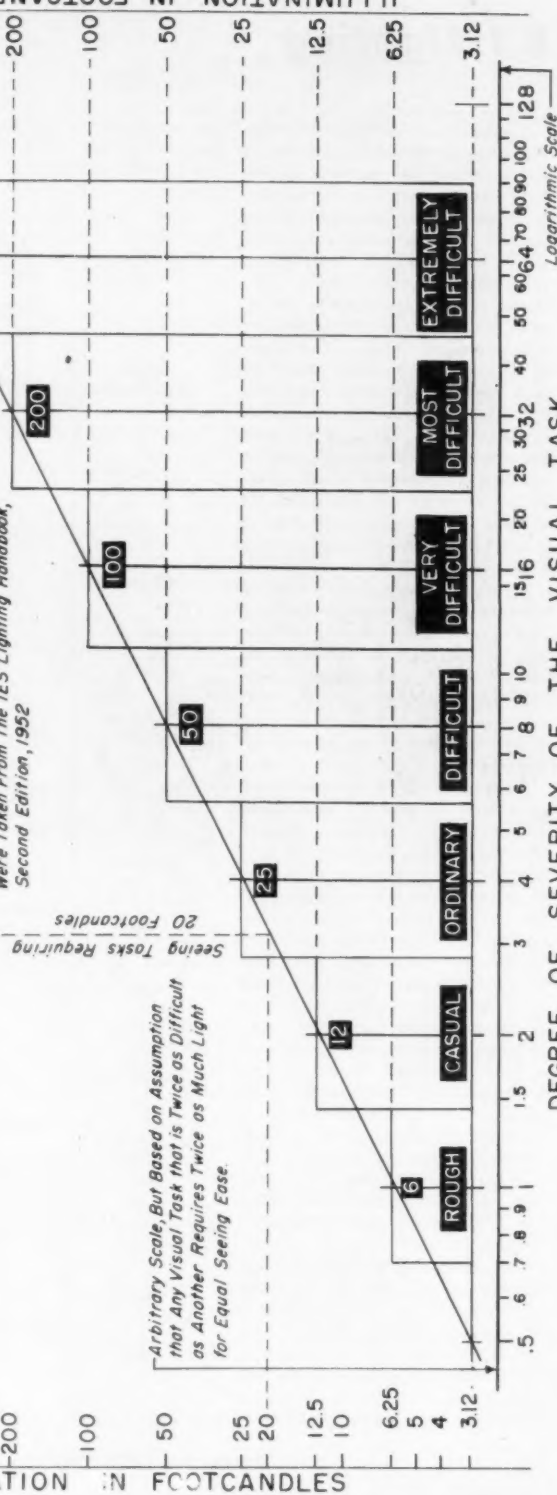


COMMERCIAL	Spotlighting	Minor Surgery
Stairways — Dining Areas—Hotel Lobbies—Food Markets — Laboratories — Show Cases	Feature Displays	
Corridors — Store Aisles—Beauty Parlors — Auto Showrooms — Wall Cases —	Show Windows	
Stock Rooms — Art Galleries (General) — Specialty Shops — Art Displays	Dental Surgery	
Theatres — Waiting Rooms — Kitchens — Department Stores — Hospital Examination		
Auditoriums — Lobbies—Ward Rooms—Mailing — Exhibition Halls		

INDUSTRIAL	Inspection — Fine Inspection	Color Identification
Storage Garages	Auto Assembly Line	
Loading Docks — Rough Testing	Finishing — Extra Fine Finishing	
Furnace Rooms — Steel Bar Mills — Leather Cutting — Stitching — Wood Carving —	Conning — Examination	
Outside Work Areas — Active Storage — Rough Machine Work —	Reading Instruments	
Rough Manual Tasks — Clay Products — Medium Assembly		
Foundries		

OFFICES	Assembly Rooms — Bookkeeping — Stencil Cutting	
Corridors — Reception Rooms—Private Offices—General Deskwork — Verifying	Drafting Rooms	
Locker Rooms — Manual Training — Study Halls — Sight Saving Rooms	Seating Rooms	
SCHOOLS		

Recommended Footcandle Values Shown Here
Were Taken From The IES Lighting Handbook,
Second Edition, 1952



- A. Use a manufacturer's name and give the trade name and/or catalog number of the luminaire specified.
- B. Give a description of the physical and photometric (light distribution) features of the luminaire specified.
- C. Describe the lighting result or illumination performance required.

In using method A above, the architect or specifier usually invites trouble unless specific limitations are placed upon the bidder at the time the original bid is submitted. Use of common phrases such as "equal to", "similar to", etc. are no assurance to the architect, specifier or owner that equipment comparable to that specified will be furnished. For an alternate method, see "Optional Equipment", Section 8.12.

Many engineers have given consideration to a performance type of specification, method C above, but it is seldom used because of difficulty experienced in writing a suitable specification which is workable. It is not covered herein.

Method B seems to be the preferred way of writing lighting specifications, and this specification is based primarily upon this method, which can also be combined with method A.

General Conditions

Luminaires and lighting equipment generally are normally furnished and installed by a subcontractor to the general contractor, such as the electrical contractor or a lighting contractor.

Scope of Work

The work covered by this specification includes the furnishing of all labor, materials, equipment and the installation of all luminaires, lighting equipment and components as shown on the plans and listed in the "Schedule of Lighting Fixtures" and as specified herein.

All luminaires and lighting equipment shall be delivered to the building complete, including canopies, suspensions of proper lengths, hickey, casings, sockets, holders, reflectors, etc., all wired and assembled. All luminaires and lamps shall be installed by the electric wiring contractor as provided for under "Electric Wiring" specification.

Wiring

Luminaires having medium base sockets shall be wired with not smaller than No. 16, and mogul sockets with not smaller than No. 14, Type AF asbestos covered wire in accordance with the latest requirements of the National Electrical Code. Fluorescent luminaires shall be wired with not smaller than No. 16 Type AF asbestos covered wire. No splice or tap shall be located within an arm, stem or chain. Wire shall be continuous from splice in outlet box of the building wiring system to lamp socket, or to ballast terminals in fluorescent luminaires.

8.12 Optional Equipment

The architect or specifying engineer has a double responsibility with his client in specifying a lighting installation. First, he must provide for adequate lighting of proper quality with suitable luminaires or lighting equipment, made of quality materials consistent with the structure in which used and the seeing problems involved. Second, he should obtain this equipment at the lowest price possible consistent with the quality of the equipment furnished. Thus specifications should be sufficiently tight to insure that lighting equipment of the exact type and quality desired is furnished, but should also have some provision to insure that bids are competitive. Since similar luminaires made by different lighting equipment manufacturers vary considerably in quality of materials used, in design and maintenance features, and otherwise, some provision should be made in the specifications whereby the bidder is permitted to submit optional equipment "similar to" that specified, and whereby the architect, engineer or owner may take his choice. The following specification paragraph is suggested for this purpose.

Luminaires or lighting equipment differing from that specified may be submitted for approval, provided the bidder clearly states all such differences and provided all essential requirements of the types specified are strictly adhered to. If the luminaires or lighting equipment offered under this provision are, in the opinion of the architect (engineer, owner) equal to or better than that specified,

they will be given consideration. Where a statement of such departures is not made with the original bid, it will be understood that luminaires or lighting equipment will be furnished in strict accordance with this specification.

8.22 Fluorescent Luminaires

8.23 General

The following specification paragraphs cover the five basic types of fluorescent luminaires classified according to their light distribution (Section 8.1). These paragraphs have been prepared for fluorescent luminaires only, since these are currently the types most commonly specified and used. At least three lighting equipment manufacturers can supply any one of the five basic types as covered in these specifications, and many manufacturers can supply one or more of the five types. The specification details in these paragraphs have purposely been made fairly rigid. If less rigid specifications are wanted, the specifier should conform the suggested covering paragraph with details relating to the specific luminaire he is willing to accept, or wants used.

Type D Luminaires

(Type D luminaires are direct lighting, and refers to systems where practically all of the illumination on the seeing surfaces is directed from the luminaire in angles below the horizontal).

Luminaires shall be of the direct recessed troffer type, such that the entire light output is in the 0°-90° zone. Luminaire shall be applicable to ceiling surfaces of plaster (metal, or the various types of acoustical tiles) and be wholly (partially) recessed above the finished ceiling as individual units or in continuous rows, as shown on drawings. Troffer shall be of the open type (or, equipped with hinged frame containing metal louvers, or baffles, translucent diffusing glass, prismatic glass, or plastics in flat or curved sections) as indicated on plans and listed in the "Schedule of Lighting Equipment."

The wiring channel shall be of not less than No. 20 gauge steel with flanged top so that supporting brackets may be attached at any point along its length. Each 48-in. or 96-in. section shall house

all ballasts, sockets, and starters (omit starters for slimline) rigidly mounted to No. 18 gauge steel stiffening straps accessible without the use of tools by lowering reflector. Detachable closed end flanged reflectors shall be of not less than No. 20 gauge steel 48-inch O.A., chemically treated to resist corrosion and to prepare a base for the application of high temperature white baked enamel finish having a reflection factor of not less than 80%. Entire assembly shall be furnished with all necessary mounting, brackets, hangers, clips, etc., at intervals most suitable to the structural ceiling design.

Luminaire shall be designed for and accommodate two standard 40 watt T-12 Type F fluorescent lamps (two 40 watt T-17 Type F fluorescent low brightness lamps, two 96-in. T-12 slimline fluorescent lamps, etc.), all as indicated on the drawings and listed in the "Schedule of Lighting Equipment".

Where troffers of the low brightness types using aluminum reflectors are required, or with other features differing from the above specification paragraph, the specifications should be altered accordingly.

Hinged Door Frame

The removable door frame with mitered corners and reinforcing cross member shall be rigidly welded to maintain close fitting tolerances through installation and maintenance handling. The door shall seat entirely within the reflector with no light leakage and shall hinge from the reflector for servicing and cleaning. All exposed trim shall be chemically treated to resist corrosion and to prepare a base for the application of a high temperature grey baked

enamel prime coat. Final finish shall be as indicated in the painting contract (or, in the "Schedule of Lighting Equipment").

Door Frame Accessories

Metal Louvers—Louvers shall be of eggcrate design providing 30° shielding crosswise and lengthwise and shall be stamped from not less than No. 22 gauge steel (aluminum) rigidly assembled to withstand all normal handling and servicing. Louver shall be held in the door frames by screwless spring type retainers. Louvers of steel shall be finished in high temperature baked white enamel. (Etched aluminum louvers shall have all surfaces protected by a suitable coating or process). Maximum brightness in the shielding zone (30° to 90° crosswise) shall not exceed 550 footlamberts and lengthwise shall not exceed 452.

Glass and Plastic Enclosures—Glass (or plastic) enclosures shall be opalescent diffusing glass (prismatic glass lenses, or any of the styrene resin or acrylate plastics) and shall further be dimensionally and chemically stable over a wide range of temperature, humidity and atmospheric conditions. The maximum permissible brightness (of any enclosing media) at any point above 60° from the vertical (direct glare zone) shall not exceed 450 footlamberts.

Type SD Luminaires

(Type SD luminaires are semi-direct lighting, and refers to systems in which from 60% to 90% of the light output from the luminaires is directed below the horizontal).

Luminaires shall be of the semi-direct type such that approximately (10% to 30%) of the light

output is in the 90° to 180° zone, and (60% to 90%) in the 0° to 90° zone. Luminaire shall be pendant (or surface) mounted. The overall efficiency in percent of bare lamp lumens shall be not less than (76%). The maximum brightness at any angle within the shielded zone shall not exceed 650 footlamberts. Moulded styrene resin (acrylate plastics, or diffusing glass) panels in combination with not less than No. 22 gauge durable etched and lacquered aluminum louvers (or steel), finished in high temperature baked white enamel shall constitute the shielding assembly. The louver assembly shall be a removable unit, firmly supported from the wiring channel and hinged from either side.

Wiring channel, reflector, cover, and end plates shall be of not less than No. 20 gauge steel, chemically treated to resist corrosion and in preparation for finishing, and shall be finished in high temperature white baked enamel. All exposed metal reflecting surfaces have a reflection factor of not less than (80%). Luminaires shall be designed for individual or continuous row mounting, and shall be for two (three, four) standard Type F fluorescent lamps (Type T-12 slimline fluorescent lamps) as indicated on the drawings and listed in the "Schedule of Lighting Equipment". All wiring shall be not less than No. 16 Type AF fixture wire. Ballasts shall be of the high power factor multi-lamp type and starters (omit starters for slimline lamps) shall be of the lock-out manually reset type. Entire luminaire and all component electrical parts shall be listed by the Underwriters Laboratories as meeting National Electrical Code requirements.

Type G Luminaires

(Type G luminaires are of the direct-indirect type, and refers to systems where the illumination is of a general diffuse character).

Luminaires shall be of the direct-indirect type, such that approximately (45%) of the light output is in the 90° to 180° zone, and approximately (55%) in the 0° to 90° zone, with not more than (7%) in the 60° to 90° zone. Luminaires shall be pendant mounted, with overall suspension

SCHEDULE OF LIGHTING EQUIPMENT

Location	Quantity	Type No.	Type	Light Source			
				Lamps per Unit	Description	Watts per Lamp	Suspension Length Ft. — In.
First Floor							
Entrance Lobby	6	A	Inc	4	PS30	200	Recessed
Guard's Office	4	B	Fl	4	48" T12	40	Recessed
Corridor	2	C	Fl	10	72" T8	51	In Coves
Office No. 100	12	D	Fl	10	48" T12	40	2 Ft.-3 In.

LUMINAIRE MOUNTING AND SPACING

COMMERCIAL

INDUSTRIAL

Mounting Height of Luminaire	Direct		Semi-Direct		Semi-Indirect		Indirect		Spread		Concentrating	
Ceiling Height for Indirect and Semi-Indirect Luminaires	D		SD		SI		I					
Dimensions in Feet	Usual Spacing Between Units		Max. Spacing Between Units		Spacing* from Walls		Spacing* from Walls		Length of Suspension		Maximum Spacing ¹ (ft.)	
8	7	7½	3	9	3	1-3	Mounting Heights Above Floor	Spacing Between Units ²	Spread	Concen ³		
9	8	8	3	9½	3	1½-3						
10	9	9	3½	10½	3½	2-3	15	12	—			
11	10	10½	3½	12	3½		16	12	—			
12	10-12	12	4	14	4	2½-4	18	18	—			
13	10-12	13	4	15	4		20	20	—			
14	10-13	15	5	17	5	3-4	22	20	—			
15	10-13	17	5	19	5		24	23	16			
16	10-13	19	6	21	6	4-5	26	25	17			
18	10-20	21	6	23	6		28	30	18			
20 or more	18-24	24	7	26	7	4-6	30 or more	30	20			

*Spacings apply where desks or benches are next to wall, otherwise one-half the spacing between units is satisfactory.

¹Units may have to be spaced closer to obtain desired illumination values.

²Where benches or machines are next to wall, spacing from wall should not exceed ½ spacing between units. Otherwise ½ unit spacing is suitable.

length as listed in the "Schedule of Lighting Equipment". Overall efficiency in percent of the bare lamp lumens shall be not less than (80%). The maximum brightness in the shielded zone (30° to 90°) shall not exceed 550 footlamberts. Maximum brightness in the shielded zone (30° to 90°) lengthwise shall not exceed 550 footlamberts.

Plastic (or glass) side panels shall be curved outwardly and so located on the luminaire that no part of the lamp extends above the upper edge. Plastic panels shall be ribbed extruded polystyrene, dimensionally and chemically stable over a wide range of temperature, humidity, and atmospheric conditions. Brightness of side panels shall not exceed 550 footlamberts. Panels shall be readily removable for maintenance without the need for tools.

End plates and wiring channel shall be die stamped of not less than No. 20 gauge steel. Suitable

connector straps shall be provided when luminaires are to be installed in continuous rows. All channels and end plates shall be chemically treated to resist corrosion and for painting and shall be finished in high temperature white baked enamel. Channel shall be so constructed as to totally enclose the ballast and wiring. All exposed metal reflecting surfaces shall be finished in high temperature baked semi-gloss white enamel having a reflection factor of not less than (80%).

The bottom of the luminaire shall be closed by means of a louver assembly which shields the lamps above (34°) from the horizontal crosswise of the luminaire and (30°) lengthwise. Louvers shall be of the removable hinged (drop or swing down) type with safety chain, permitting ready access to the ballast and wiring. All wiring shall be not less than No. 16 Type AF fixture wire.

Ballasts shall be of the high power factor multi-lamp type. Starters shall be of the lock-out type, manually reset. Luminaire shall be designed for two (four, six) standard 40 watt T-12 Type F fluorescent lamps (two 96-in. T-12 slimline fluorescent lamps, etc.) as indicated on the drawings and listed in the "Schedule of Lighting Equipment".

All luminaires meeting Type G specifications, if surface mounted, may also be classified as semi-direct (Type SD) type.

Type SI Luminaires

(Type SI luminaires are of the semi-indirect type, and refers to systems in which 60% to 90% of the light output from the luminaire is emitted above the horizontal).

Luminaires shall be of the semi-indirect type, such that approximately (60% to 90%) of the light output is in the 90° to 180° zone and (10% to 40%) in the 0° to

90° zone. Luminaires shall be pendant mounted. Stem suspensions shall be (27 inches) overall. The overall efficiency in percent of the bare lamp lumens shall be not less than (71%). The maximum brightness at any angle between 45° and 90° crosswise shall not exceed (150) footlamberts. Moulded plastic (or glass) reflectors shall be so located on the luminaire that no part of the lamps, ballast or ballast shield extends above the upper edge. Reflectors shall be readily removable for maintenance without the need for tools.

Wiring channels shall be formed of not less than No. 20 gauge steel of sufficient size to provide for all necessary wiring. High power factor multi-lamp ballasts and lock-out type manually reset starters shall be mounted on the top of the wiring channel. All wiring shall be not less than No. 16 Type AF fixture wire. Complete luminaire, including ballast, wiring, lamp-holders and starters (omit starters on slimline lamp units) shall be listed by Underwriters' Laboratories as meeting National Electrical Code requirements.

Luminaire shall be designed for two standard Type F fluorescent lamps (two 96-in. T-12 slimline fluorescent lamps) as indicated on drawings and as listed in the "Schedule of Lighting Equipment".

Some luminaires having design and structural characteristics similar to those meeting the requirements for Type G direct-indirect luminaires but intended for use with four or six fluorescent lamps, because of the wider top opening, will meet the zonal distribution requirements for Type SI semi-direct luminaires. Such units may, however, exceed the maximum brightness (150 footlamberts) specified for Type SI units. Various glasswares or plastics are available which may be used in place of louvers to meet the 150 footlambert limitations.

Type I Luminaires

(Type I luminaires are of the indirect lighting type, and refers to systems where from 90% to 100% of the light from the luminaire is emitted above the horizontal to light the ceiling and upper side walls. The light is thus diffusely reflected from the ceiling and side walls to the work surfaces in the room below. Luminaires similar in

design characteristics to Type SI luminaires, but having metal reflectors or suitable glass or plastic reflectors will meet this classification).

To specify Type I luminaires, use the specification for Type SI luminaires, altered insofar as luminaire body is concerned, using the following specification to cover the indirect reflectors:

Reflectors shall be formed of not less than (No. 22) gauge steel chemically treated to prevent corrosion and to form a base for finish, and finish in a high temperature white baked enamel finish with a reflection factor of not less than (80%) (or etched aluminum with Alzak finish having a reflection factor of not less than (75%)).

3.24 Luminous Ceilings

A comparative newcomer to the practice of lighting design is the luminous ceiling. Although used in many installations as "artificial skylights" 25 to 30 years ago, using incandescent lamps above leaded glass ceilings, or panels of ornamental and decorative glass, it is now being used to provide high quality utilitarian light for critical seeing tasks.

Luminous ceilings are classified as a direct (Type D) lighting system, since all its light output is below the horizontal of the luminaire, or below the ceiling line.

A luminous ceiling system comprises a hung or suspended ceiling using translucent plastic or other diffusing material to form the ceiling, which is lighted from above. Usually the entire ceiling, or a large portion of it, becomes the light source. For specification purposes, ceilings formed of louvers (plastics, aluminum, steel, wood or glass) are also considered here as luminous ceilings, since for all practical purposes their construction, lighting characteristics and installation details are the same.

The quantity and quality of light produced by a luminous ceiling depends upon the following factors:

A. Type and spacing of lamps.

B. Efficiency of the diffusing media.

C. Reflectances of the ceiling, side walls, ducts and other surfaces within the plenum, and in the room area below the luminous ceiling.

Recommended reflectances referred to in (C) are: side walls—50%; floor—30%; furniture—30%; and plenum—80% or above.

Luminous suspended ceilings for decorative and utilitarian purposes, acoustical correction, and to provide spaces for air ducts, piping, etc., are adaptable to both new and remodeled building structures. Being an integral part of the structure, the architect should consider detailing many of the component parts on the architectural, mechanical and electrical plans. These details may be supplemented by the following specification paragraphs modified as required by structural or other requirements on any specific installation.

The wiring contractor shall furnish and install all wiring, wiring channels, mounting frame and plastic (glass) diffusing panels as called for in these specifications and as detailed on the drawings.

Method of assembly is shown on drawing No. (—). Vinyl resin flexible plastic sheets (acrylate corrugated plastic panels — give details) shall be held in place by T and U shaped channels formed of not less than No. 20 gauge steel chemically treated to prevent corrosion and as a preparation for the finish which shall be high temperature white baked enamel. The projections upon which the plastic sheets rest and slide into shall have

LUMINOUS CEILING COEFFICIENTS OF UTILIZATION

Room Index	Reflection Factors		
	Ceiling — 75%		
	Walls		
	50%	30%	10%
A	.57	.55	.53
B	.55	.52	.50
C	.52	.49	.46
D	.49	.46	.43
E	.46	.42	.39
F	.41	.37	.33
G	.38	.32	.29
H	.33	.28	.24
I	.27	.22	.19
J	.22	.16	.12

From IES Lighting Handbook.

a one-inch wide horizontal projection, as shown in the drawings. Channels shall be spaced as shown on drawing No. (—), and suspended by wire or adjustable metal straps from the building structure in such a manner as may be required to maintain straight and level position. Acoustical control where called for shall be obtained by the use of hollow perforated metal fins, finished in white enamel, containing a sound absorbing pad, hung at intervals from the U shaped channels, all as shown and detailed on drawing No. (—).

Lighting wireway channels for (96-inch T-12 slimline fluorescent) lamps shall be spaced and hung above the plastic sheeting in accordance with the lighting layout and mounting details as indicated on drawing No. (—).

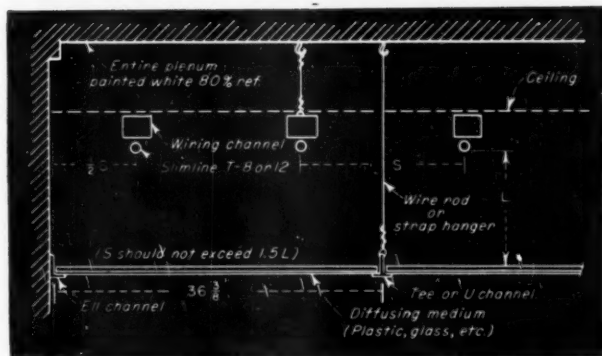
Automatic sprinkler heads may be mounted in the plenum above Vinyl resin plastic sheets, as approved by the Underwriters' Laboratories, Inc., and by the National Board of Fire Underwriters. Where acrylic plastics are used, sprinkler heads may be mounted in U-channels specifically designed for this purpose, or in suspended ceiling areas provided by the architect in the luminous ceiling design pattern for this purpose.

For acrylate plastics in corrugated, flat or moulded patterns, and for metal or wood louvers, the supporting T bars and U channels should be heavier to support the additional weight, as compared with the support members for the lightweight Vinyl resin plastic sheets.

8.31 Industrial Reflectors

General

With few exceptions industrial lighting design is normally classified under Type D or Type SD. Different light sources may be employed—incandescent, fluorescent, or mercury vapor—depending upon the specific application, design and other considerations. To obtain uniform lighting throughout an industrial area or over a specific industrial process three basic light distributions or variations of them are obtainable from reflectors made of porcelain enameled steel, aluminum, prismatic glass, silver mirrored glass, and the self contained reflector type of spot and flood lamps. The three



Section Through Typical Luminous Ceiling

SPACING BETWEEN ROWS OF FLUORESCENT LAMPS TO GIVE 100 FOOTCANDLES*

Room Coefficient	40 Watt T-12 75 Watt T-12 96" Slimline	Slimline, T-8, 72" or 96"					
		120 Ma.		200 Ma.		300 Ma.	
		72"	96"	72"	96"	72"	96"
		26W.	34W.	38W.	51W.	51W.	69W.
0	61.1 in.	9.3 in.		42.6 in.		53.2	
0.1	53.7	25.7		37.4		46.7	
0.2	47.5	22.7		33.0		41.3	
0.3	42.1	20.3		29.3		36.7	
0.4	37.6	18.0		26.2		32.6	
0.5	33.5	16.1		23.3		29.2	
0.6	30.0	14.4		20.8		26.2	
0.7	26.9	12.8		18.7		23.3	
0.8	24.0	11.6		16.7		20.9	
0.9	21.6	10.3		15.0		18.9	
1.0	19.3	9.3		13.4		16.9	

*Initial Illumination Based on 3500° K Lamps. From June 1951 Illuminating Engineering.

basic light distributions are: wide spread, medium spread (semi-concentrating), and concentrating. Specification paragraphs below cover these various types of reflectors classified first by type of light source, second by type of light distribution, and third by type of reflector material.

8.32 Incandescent Lamp Reflectors

Standard RLM Reflectors

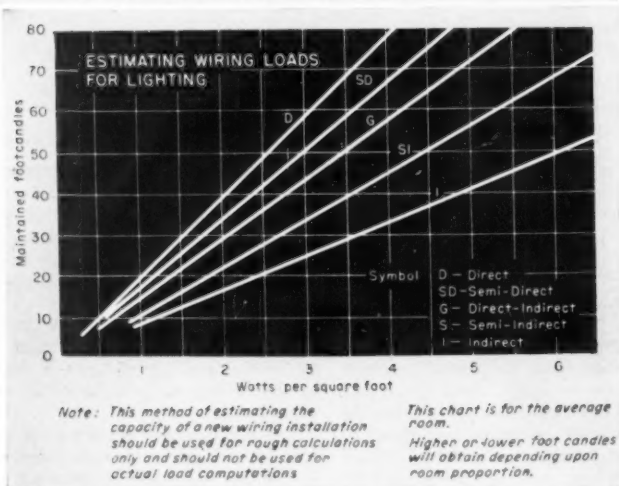
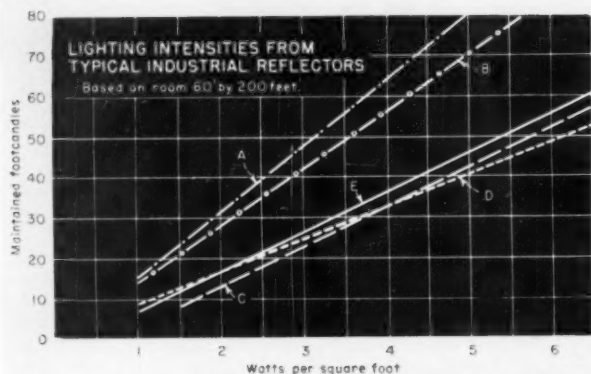
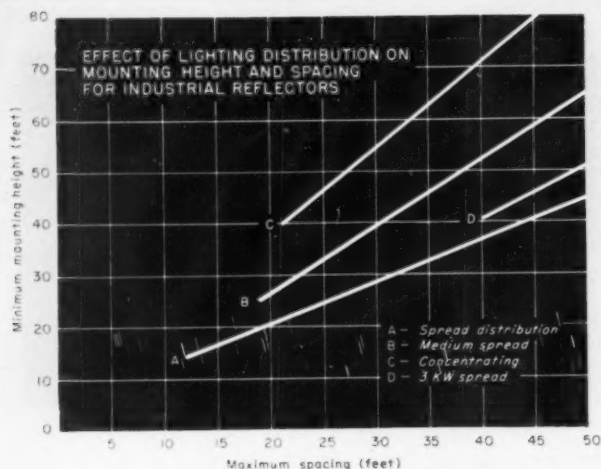
Spread type distribution (normally used up to 25-foot mounting height).

RLM type reflectors meeting the following specifications shall be used in locations indicated on the drawings and as listed in the

"Schedule of Lighting Equipment".

Reflector shall be made of porcelain enameled steel of not less than 0.025-in. (24 gauge) in thickness, except for the 500 watt and 1000 watt sizes which shall be made of steel of not less than 0.031-in. (22 gauge) thickness. The reflecting surface shall be covered with at least two coats of separately fired white porcelain enamel over a ground coat of fused porcelain enamel. The outside surface shall be covered with at least two coats of fused porcelain enamel separately fired.

The reflector shall present a continuous surface so proportioned that when used with the incandes-



cent lamp for which designed the filament center will be cut off from view at an angle of 72.5° from the vertical axis. It shall be equipped with an integral husk containing keyless, rigid, medium socket (mogul socket for 500 watt and 1000 watt sizes) so that no other position than this can be obtained.

The reflecting surface shall have a mean reflection factor of 79% and a minimum of 76.5%. The output of the reflector shall be at least 78% of the light generated by the bare lamp with a maximum ratio of 1.35 between the maximum candlepower from 0° to 15° and the average candlepower values at 25° , 35° , and 45° after subtraction of bare lamps valued at corresponding values.

Female type fitting tapped $\frac{1}{2}$ -inch standard shall be provided for mounting.

(If reflectors sub-standard to RLM reflectors are acceptable, the above specification may be altered to accept such reflectors as may be adequate.

Aluminum Reflectors

Medium spread type distribution (normally used for mounting heights from 20 to 40 feet).

Concentrating type distribution (normally used for mounting heights of 35 feet and above).

Aluminum spread and concentrating type reflectors meeting the following specifications shall be used in locations indicated on the drawings and listed in the "Schedule of Lighting Equipment".

Reflector shall be formed of 0.064-in. sheet aluminum. It shall have a light etch and Alzak finish inside and out with a minimum reflection factor of 75%. The socket cover shall be constructed of 0.050-in. aluminum and etched outside, with a baked flat black finish inside. Large apertures shall be provided for ventilation of the socket. Mogul ventilated type socket tapped for $\frac{1}{2}$ -inch conduit shall have a base contact of non-corrosive metal, cup shaped, to permit broad contact surface for the lamp base. The current carrying conductor to the base contact shall be laminated. Pressure on the base contact shall be maintained by a non-current-carrying spring of non-corrosive metal.

Reflector shall have an overall efficiency of not less than (—) %.

Luminaire shall be approved by the Underwriters' Laboratories, Inc., and shall carry an Alzak Process label or stamp.

The dust-tight unit shall have a standard socket cover without ventilating apertures. The reflector flange shall shield the gasket from water and dirt and provide ample gasket sealing and clamping surface. The door shall be cast aluminum to provide rigid seating for a 16-inch diameter tempered glass cover, both of which shall be furnished as part of the unit. It shall hinge freely for maintenance and be secured by three wing-nut screw clamps.

Glass Reflectors

Prismatic glass concentrating type reflectors meeting the following specifications shall be used in locations indicated on the drawings and listed in the "Schedule of Lighting Equipment".

Reflector shall be pressed moulded prismatic glass, heat tempered to withstand a mechanical shock of 8 foot-pounds, and thermal shock of 100° C., and shall be complete with porcelain mogul socket having nickel plated screw shell and contacts entirely outside of reflector. Steel tripod type of holder and ring shall firmly grip the reflector from below. Tripod shall terminate in a slip ring collar to provide exact positioning of the lamp. Glass reflector shall have a permanently spun steel or aluminum cover with auxiliary drip cover to protect the lamp. All ferrous parts shall be cadmium plated to resist corrosion. Fixture shall be wired with No. 12 stranded Type AVA wire. Reflector shall have an overall efficiency of not less than (—) %.

Mirrored Glass Reflectors

Reflector shall be of crystal clear blown glass slightly corrugated to produce the exact light distribution required and to eliminate filament striations. Glass shall be free of color, bubbles, seeds and scratches. The e.g.s shall be ground smooth and shall not be chipped or cracked. The silver reflecting surface shall be protected by a suitable backing that will withstand the heat of the lamp for which the reflector was designed without chipping, peeling, or caus-

ing the silver reflecting surface to tarnish or discolor in any way whatever. Steel tripod type holder and cast ring shall support reflector from below. Tripod shall terminate in a vibration-proof ventilated holder gripping the top of the reflector. All metal supports shall be chemically treated to prevent corrosion and to provide a base for a high temperature baked gray enamel finish. Fixture shall be wired with No. 12 stranded Type AVA wire. Reflector shall have an overall efficiency of not less than (—) %.

8.41 Fluorescent Lamp Reflectors

General

Fluorescent lamps inherently provide diffuse illumination because of their size and shape and method of producing light; hence they are most suitable for spread type light distribution and for mounting heights of 12 to 30 feet above the floor. They may also be used satisfactorily at greater mounting heights, up to 50 feet, provided the width of the area where used is at least five times the mounting height, and proper facilities for servicing are provided.

Spread Type Distribution

Industrial fluorescent reflectors are normally made of porcelain enamel steel, baked white enamel steel, or aluminum. Typical specifications for a fluorescent lamp reflector luminaire equipped with a white porcelain enamel reflector is given below. Similar luminaires except equipped with steel reflectors having a high temperature baked white enamel finish, or with aluminum reflectors having an Alzak processed finish, may be similarly specified by suitably altering the specifications for the reflectors.

Enameled steel reflectors meeting the following specifications shall be used in locations indicated on the drawings and listed in the "Schedule of Lighting Equipment".

The wiring channel shall be formed of not less than No. 20 gauge steel having flanged top to stiffen and provide a point for attachment along its entire length of clamp-type hangers. Channel shall be completely wired and shall further be equipped with Certified multi-lamp ballasts, starters (omit starters for slimline lamp reflectors), and lampholders. Channels

shall be 48-in. or 96-in. long for individual or continuous row mounting, chemically treated to prevent corrosion and to prepare a base for the application of high temperature white baked enamel. Reflector shall be of special enameling steel stock of at least No. 20 gauge, with closed or open ends as indicated. All porcelain enameled surfaces shall be free from such defects as tears, star marks, crazing, blisters, black specks, hair lines, chipping, pin holes, and other irregularities. The lower edge of the reflector shall be flanged or beaded to provide adequate stiffening. Reflector shall be readily removable from the wiring channel without the need of tools.

The overall efficiency of the complete unit in percent of the bare lumens shall be not less than 72%. Fixtures shall conform to RLM standard specifications.

8.51 Mercury Vapor Lamp Reflectors

General

Mercury vapor light sources which have proven popular for industrial lighting are most commonly used in the 3-kw, 1000-watt and 400-watt sizes. Usual practice is to use the 3-kw lamps for high bay lighting with mounting heights of 35 feet and above, and 1000-watt and 400-watt lamps for low and medium bay areas with wide and medium spread reflectors, or for high bay areas with concentrating type reflectors.

3-kw. Concentrating Type Reflectors

(Spacings should not exceed 0.8 times the mounting height).

Aluminum Alzak finished reflectors meeting the following specifications shall be used in locations indicated on the drawings and listed in the "Schedule of Lighting Equipment".

Wiring channel shall be of extruded aluminum having flanged top and bottom with two cast aluminum flange fittings to provide mounting by ¾-in conduit. Reflector shall have closed ends and be formed from 0.040-in. sheet aluminum with Alzak finish. Reflector shall have a series of apertures along each side of the wiring channel over which shall be a ribbed 0.040-in. anodized aluminum plate

permanently attached to the reflector to stiffen it and serve as a shield above the ventilating apertures. The lower edge of the reflector shall be flanged or beaded to provide further stiffening. Units shall be wired with No. 14 Type AVA single conductor wire. The overall efficiency in percent of bare lamp lumens shall not be less than (67)%.

3-kw Spread Type Reflectors

(Spacings should not exceed mounting heights, and 3-kw. spread type reflectors should be installed not less than 35 feet from the floor in order to prevent direct glare.

White porcelain enameled steel reflectors meeting the following specifications shall be used in locations where wide spread type light distribution is required for 3-kw mercury vapor lamps, as indicated on the drawings and as listed in the "Schedule of Lighting Equipment".

Two terminal housing formed of not less than No. 20 gauge steel connected by a conduit wireway shall comprise the wiring channel. Terminal housings shall have removable covers to permit easy access to the lampholder terminals. Housings and wireways shall be chemically treated to prevent corrosion and to prepare a base for the application of high temperature baked enamel finish.

Reflectors shall have open ends with rounded corners and be formed of special porcelain enameling steel stock of at least No. 20 gauge. The lower edge of the reflector shall be flanged to provide stiffening. Reflectors shall be readily removable from the terminal housings without the need of special tools.

Units shall be wired with No. 14 Type AVA single conductor cable. The overall efficiency of the entire luminaire, in percent of bare lamp lumens shall be not less than (79)%.

Ballasts or transformers for the 3-kw mercury vapor lamps differ in size and electrical characteristics, and are too large for mounting within the reflector luminaire housing. Therefore they are usually furnished for single or multi-lamp operation and mounted on a chord or I-beam (some structural member) of the roof structure adjacent or nearby to the luminaire.

1000 and 400-Watt Reflectors

Mercury vapor lamps in the popular 400 watt and 1000 watt sizes may be used in the standard industrial incandescent reflectors covered in Section 8.32. Light distribution characteristics of standard incandescent reflectors do not vary greatly when mercury vapor light sources are substituted for the incandescent lamps, and for all practical purposes may be used with either light source. Ventilated neck husks are considered desirable when mercury lamps are used, to provide cooler operation for these lamps, and many manufacturers provide such ventilation. Where exact light distribution characteristics are needed for reflectors using mercury vapor lamps, the reflector manufacturers can usually supply this information.

When color discrimination is required or where fast rotating machines are present in the area being lighted, incandescent reflectors should be used alternately with mercury vapor lamp reflectors, or in combination, mounting the mercury and incandescent reflectors side by side from the same suspension assembly. Use of equal wattages of incandescent and mercury vapor lamps will minimize stroboscopic effect, and use of equal incandescent and mercury vapor lumens will provide good color discrimination.

Mercury lamps require a starting period of from four to seven minutes to enable the lamp to reach full brilliance. Interruption of the power supply, or a sudden drop in voltage of 15% or more, extinguishes the lamp so that a new starting period is required. This is another reason for combining incandescent lamps with a mercury vapor lighting system.

8.55 Reflector Lamps

There is a rapidly growing acceptance by industry of the self-contained reflector type lamps.

Used in locations where the air is burdened with smoke, dirt, or non-explosive chemical fumes, these lamps will maintain their light output to a high degree throughout their life without costly maintenance.

The R-52 reflector lamp, classified as medium spread, is an incandescent light source available in 500- and 750-watt sizes, and may be used for mounting heights from 25 to 40 feet. Spacing should not exceed the mounting height above the work level.

A new self-contained reflector-type

lamp is the 800 watt R-57. It has a concentrating light distribution, and is suitable for mounting heights above 40 feet. Spacing of the R-57 should not exceed 0.7 times the mounting height above the work level. The rated average life of these lamps is 2000 hours. Light distribution curves showing candlepower at various angles are available from the various manufacturers of these reflector lamps.

A reflector-type mercury vapor lamp has also been announced in the 400-watt size. It is available in the standard mercury vapor (clear bulb) type, and in the new fluorescent color corrected (phosphor coated) bulb type.

Reflector lamps require no separate reflectors but do require a Mogul screw shell socket and a suspension or mounting arrangement. Metal reflectors for mechanical protection only of the lamps may also be considered desirable for some installations.

Where these lamps are specified exact method of suspension should be indicated on the drawings and the lamps should be specified by wattage and bulb designations as provided by the lamp manufacturers, and the entire assembly given a "Type" number and listed in the "Schedule of Lighting Equipment".

8.56 Hazardous Area Lighting

Areas which contain inflammable dusts, vapors, or gases in explosive concentrations are classified as hazardous by the National Electrical Code, according to the degree of hazard involved. The NEC requires that luminaires used in such areas be explosion-proof, in that they will protect the area from any explosion occurring within the luminaire.

For less hazardous areas, where the atmosphere contains non-inflammable dusts and vapors, so-called dust-tight and vapor-tight luminaires are permissible.

It is suggested that specifiers contact the manufacturers of any specific vapor-tight or explosion-proof type luminaires which he proposes to specify direct for a detailed specification of the particular luminaires involved, since individual designs vary considerably in materials, mechanical and structural design details, and otherwise, from one manufacturer to another. Use of the manufacturer's name, catalog number, and general description may also be used in the specification, if desirable.

9.1 Motors and Controls

9.11 Motors

Motors for operating (fans, pumps, blowers, compressors, other constant-speed operations) shall be of the synchronous (engine, belted, coupled) type arranged for (horizontal, vertical) operation and rated at — hp, — volts, — phase, — cycles, — percent P.F., — rpm. (It, they) shall be capable of developing a starting torque of — percent full load torque, a pull-in torque of — percent full load torque, and a pull-out torque of — percent full-load torque.

The motor and its control together shall limit the kva inrush at starting to — percent of full load kva. The motor field shall be excited from a (direct-connected, belted, or motor-generator-set exciter).

The following shall be stated and guaranteed: Maximum temperature rise stator — degrees C, field — degrees C; maximum excitation required — kw at — volts; efficiencies at — percent P.F. for full load —, $\frac{3}{4}$ ths load —, half load —.

Controls for (fan, pump, etc.) motors shall provide for (full, reduced voltage) starting of the — hp, — rpm, — percent P.F., — volts, — phase, — cycle motors and shall be provided with NEMA I enclosures, and designed for (full magnetic, semi-magnetic) operation. Reduced voltage at starting shall be obtained by means of (autotransformer, reactor, resistor) and shall limit the kva inrush to a maximum of — percent of full load kva.

The control shall provide for overload, undervoltage, damper winding and pull-out protection and, after pull out of step, will automatically (stop, resynchronize) the motor. Control shall be manufactured by —, type —, or approved equal.

Motors for operating (elevators, conveyors) shall be of the polyphase squirrel-cage induction type rated for — hp, — volts, — phase, — cycles, — rpm, of NEMA design (B, C), with ball bearings and NEMA Class A insulation. Enclosures shall be (open drip-proof,

splash-proof, fan-cooled totally-enclosed).

Controls for squirrel-cage motors shall be enclosed combination 3-pole across-the-line starters with circuit breakers in NEMA type — enclosures with self-indicating handles and shall provide overload, low voltage and short circuit protection. Breakers shall trip at — amps. Remote 2-unit standard duty pushbutton stations, momentary-contact, marked Start-Stop, shall be provided in NEMA type — enclosures. Starters shall be manufactured by —, Class —, Type —, or approved equal.

Motors for (door openers, machine tools) shall be single-phase capacitor-start units rated for (110, 220) volts, — cycles, — rpm, with (sleeve, ball) bearings, NEMA Class A insulation, 40 degrees C continuous temperature rise.

Controls for these motors shall consist of manual across-the-line starters in NEMA type — enclosures providing thermal overload protection and having self-indicating handles. Circuit protection shall be provided by fusible safety switch.

Motors shall be located as indicated on the drawings, positioned so as to permit unhindered maintenance, bearing lubrication and brush replacement. Totally-enclosed motor housings shall be used where conditions of excessive moisture, steam, dripping oil, dust, acid fumes or explosive atmospheric conditions exist.

Starting devices, controllers, relays, thermostats and photocell switches shall be connected to all motors in (rigid or flexible conduit, armored cable or EMT). Where motors have conduit terminal boxes, feeder conduit shall be connected directly into same. Fans and pumps and all motors having sliding bases shall have not less than 18 inches nor more than 6 feet of armored flexible conduit from end of rigid conduit to motor terminal box. Under no circumstance shall rigid conduit terminate in or be fastened to motor foundation. Power supply leads to motors from controllers shall conform to drawings and recommendations.

Stationary motors shall have grounded frames when the motors operate at over 150 volts to ground when (1) they are located in unguarded, moist locations, (2) when they are connected to metal-enclosed branch wiring circuits, and (3) when they are located in hazardous locations. Grounding shall be accomplished by connecting the branch cable armor to the motor frame.

Portable motors shall be grounded in like manner when these units operate at over 150 volts to ground, and *should* be grounded whenever readily accomplished. Motor frames shall be grounded by use of a jumper attached to the frame and connected to the conduit supplying the feed of the motors.

Grounding of disconnect switches, starters, controllers, cabinets and the like shall be accomplished by the use of double locknuts and bushings attached to clean bare metal surfaces void of any paint.

9.21 Controls

Where several motors of like capacities, design, characteristics and purpose are installed, it is convenient to include detailed and specific specifications concerning the methods of control with the specifications of the motors themselves. This procedure is indicated by the typical motor-control specifications just presented. However, when numerous motors of widely varying capacities, characteristics and functions are to be installed, a general specification can be written to cover all general control equipment, with additional clauses covering those installations which do not follow the pattern.

Such general specifications could follow the examples presented below. Concerning these general clauses, it should be mentioned that only the more common types of general-purpose motor control devices for alternating current motors are referred to. To specify controlling equipment for special applications, it is well to consult the manufacturers for wiring.

Controls

Each motor rated at 1/6 hp or over shall be equipped with a starter or controller which will

provide running overcurrent protection for the motor. Overcurrent devices shall open all leads to the motor except that for two-phase motors, only three leads are required to be opened. All starters and controllers shall be enclosed in substantial metal enclosures and shall conform with the NEMA Industrial Control Standards.

Type A starters shall be manually operable by means of a lever, knob or pushbuttons, for full-voltage starting.

Type B starters shall be magnetically operable, for full voltage starting, and shall be provided with undervoltage protection. Provision shall be made for remote control by means of wires leading to other control stations.

Type C starters shall be of the manually operable autotransformer type, for reduced voltage starting. Each starter shall be provided with undervoltage protection and shall have a stop pushbutton in the cover.

Type D starters shall be of the magnetically operated autotransformer type for reduced voltage starting. Each starter shall be provided with undervoltage protection and shall be arranged for remote control.

Type E starters are for use with wound-rotor motors for starting duty only. Each controller shall consist of an assembly of a magnetically-operated primary switch and a resistor switch with suitable resistors. The primary switch shall provide running overcurrent protection and undervoltage protection for the motor. The resistor switch shall be electrically interlocked with the primary switch so that the primary switch cannot be closed unless all resistors are connected. Resistor switches shall be of the dial type for motors of 10 hp rating or less and shall be of the drum type for larger motors.

Type F controllers are for use with wound-rotor motors for speed regulation duty and shall provide for 50% speed reduction and continuous operation at any speed from maximum to minimum. Type F controllers shall in all other respects conform with the specifications for Type E starters.

All control equipment shall be mounted with operating levers or pushbuttons at a height of ap-

proximately four feet above the floor. All necessary expansion bolts, brackets and other structural steel parts shall be furnished to provide secure mounting on walls, columns or machine frames as indicated on the plans or, where so indicated, equipment shall be mounted on frames.

Disconnecting means: Where required by the National Electrical Code, a manually operable disconnecting means shall be provided for each motor or for each group of motors driving the several parts of a single machine.

9.22 Remote Control

Conservation of space, safety or convenience frequently determines the selection of a controller site removed from the motor it controls. In such a case, a magnetic control panel at the remote point and a small pushbutton station at the machine for the operator is suggested. Since only small control wires need be run between pushbutton stations and the controller, added operating convenience can be obtained by installing a number of pushbutton stations for the same motor, or control type limit switches can be substituted for the pushbuttons.

Remote control is particularly advantageous for operating cooling-tower fan motors, ventilators and the like. When pilot lights and audio signals are also installed, supervision is simplified to a high degree.

All fans and other motorized equipment as shown in the feeder diagrams and schedules shall be provided with auxiliary relays at starter locations, with control wiring connections made into starters and to a master pilot light and control panel in engineer's office. There shall be a pilot light for each fan motor. For the cooling tower fans on the roof, start-stop remote control pushbuttons shall be provided under the pilot light for each tower fan. For all other fan motors, a stop pushbutton station shall be provided and mounted under their respective pilot lights.

Relays, pilot lights and remote control pushbutton stations shall be of such type and so wired that a pilot light operates when motor operates, and pushbuttons permit remote stopping of motors individually, or start-stop control of cooling tower fan motors.

9.31 Motors and Control by Others

Motors and motor control apparatus shall be furnished and installed complete with all wiring as listed in accordance with other sections of these specifications, control apparatus for these motors will be furnished by others, but shall be installed under this contract.

All wiring and disconnecting means, where required, shall be furnished and installed for motors listed in accordance with other sections of these specifications. Motors and control apparatus will be furnished by others.

9.41 Electronic Controls

For apparatus shown on plans to be electronically controlled, furnish and install the controls listed complete with all wiring in operating condition. (List control elements required. For example, light source, photocell pickup, amplifier, relay, controller, etc.) Furnish two copies of wiring diagrams and maintenance instructions. Provide one complete set of replacement tubes.

Photoelectric Control

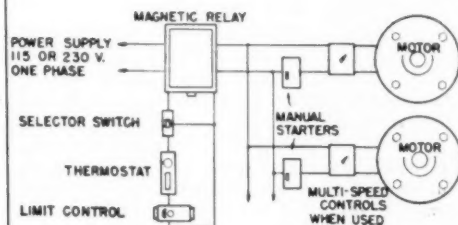
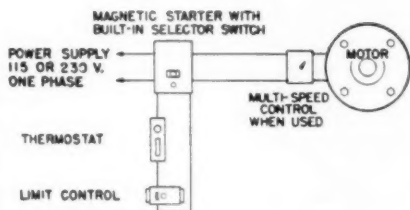
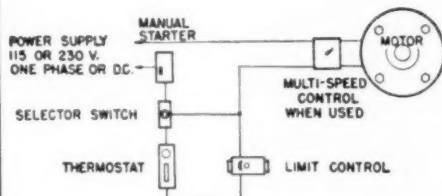
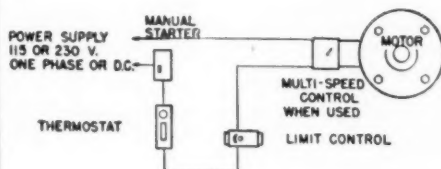
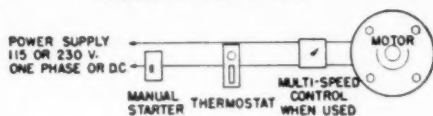
Furnish and install photoelectric relays and associated equipments in each location indicated on drawings. Each relay unit shall have double-pole double-throw magnetic relay and a photoelectric amplifier circuit consisting of a phototube, thyratron tube, transformer, potentiometer, necessary capacitors and resistors.

Separate phototube holder with six feet of rubber-covered, shielded cable, external mounting bracket and required tube socket shall be included with each relay unit.

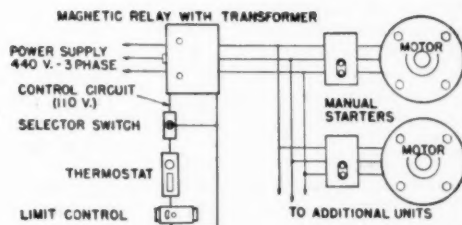
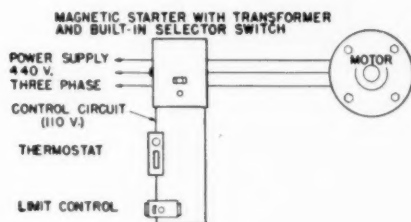
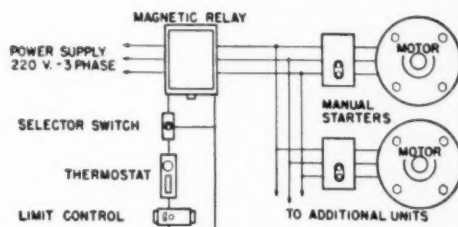
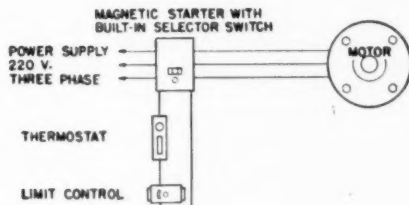
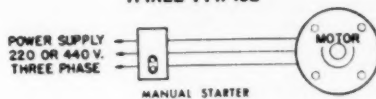
Light sources will have die-cast light-tight removable covers and automobile headlights, internal brackets to permit adjustment of lamps for height and distance from lens, and tapped holes in bases of chassis to permit mounting of light sources directly on transformer.

Light source transformers shall be rated for 115 volts, 60 cycles primary; 4.8 volts secondary. Integral connection boxes shall have knockouts in bottoms, rears and sides. Covers shall be removable for access to primary leads and for making connections to incoming lines. Half-inch pipe nipples shall

SINGLE PHASE or D.C.



THREE PHASE



Wiring and controls for single phase or 3-phase motors.

extend through end shields for mounting the light sources.

Large light-collecting lenses with 4.5-inch focal lengths, and holders for same, shall be furnished for each light source and each separate phototube holder.

9.51 Ventilation and Air Conditioning

Ventilation and air-conditioning equipment is available in a wide selection of packaged, easily-installed forms. It combines fine engineering, trouble-free performance and rugged construction. Choice of equipment is extensive, ranging from air movement only to the fields of controlled humidity, temperature, motion and the removal of dust, gasses or bacteria from the atmosphere. Air movement only satisfies the requisites of ventilation, with fans and exhaust units available for supplying or removing air to or from enclosed space by either natural or mechanical means. Complete air conditioning units are of course more comprehensive in their equipment and control.

In most instances the installation of unit air-control apparatus combines the mechanical problems of locating and attaching the equipment with the electrical problems of wiring and control. Substantially, this covers the same scope and involves much the same techniques used to install most types of electrical equipment.

Since air conditioning is becoming *essential* in many hot industries and is being recognized as a *highly desirable* factor in commerce and the home, it is referred to more and more in comprehensive electrical specifications.

Where close control and exact capacities are not critical, savings can be achieved by specifying factory-assembled units combining air handling with condensing equipment in a single cabinet, balancing the capacities of coil and condenser. These combination units widen the compromise between actual load and rated capacities of the conditioners, but units of $\frac{1}{2}$, $1\frac{1}{2}$, 3, 5, $7\frac{1}{2}$, 10 and 15 tons refrigeration capacity are proving economical in many locations.

As to component parts, factory-assembled cooling units consist of (1) airtight sheet-steel casings having removable panels for access to coil connections, blower bearings and other essential parts, (2) insulation for water, vermin, sound and heat protection,

(3) drain pans treated to resist the corrosive action of the mild acids absorbed by the condensate, (4) blowers with oil cups conveniently located outside the casing to promote lubricating facilities, (5) cooling and dehumidifying coils, filters—either throw-away or cleanable—and (6) motors, usually located outside the unit to decrease the absorbed heat within the enclosure and to permit ready access for servicing.

Vibration dampeners of either felt, sponge or rubber-in-shear should be used to isolate and minimize the transmission of sound or motor motion. Floor and beam loadings should be checked before installing conditioners, for suspended units can add up to 100 lbs./sq. ft., and self-contained units can double that figure. Where floor or roof construction is on the minimum side, this added strain could easily cause deflection, the creation of fire passages or the dropping of the equipment.

Wiring should be sufficiently heavy to minimize voltage drop, for voltage drop has a definite effect on equipment life through slower starting. A separate circuit is not only desirable, but definitely necessary in most instances, for combined light-and-power circuits will adversely effect the lighting potential. Air-conditioning circuits should be 12-gauge or larger, with flexible conduit used for motor connections to prevent sound and vibration transmission. To avoid confusion with light switches, control switches for air control equipment (either single or 3-way) should be located at least a foot above the customary height of the light switches.

If a constant check on operation is desired, the use of a pilot indicating light is recommended. An additional recommendation is to install a quartz fuse link in the air intake duct, set to operate at 140° F, so linked that a cut-off switch in series with the fan motor will take the unit out of service in case of fire.

9.52 Fans

Furnish and install where shown on plans the following built in propeller fans.

In the opening provided by others furnish and install a propeller fan to have a capacity of cubic feet of air per minute, at a speed not exceeding-rpm, and with a decibel rating not to exceed —. The fan wheel shall be dynami-

cally balanced and mounted directly on the motor shaft. The motor shall be dynamically balanced and provided with high quality bearings. The complete fan, including the motor, is to be guaranteed as a unit by the manufacturer who is to assume undivided responsibility.

On the exterior furnish and install a shutter (motor operated, manually operated, automatic) of the following size and type —.

Fan shall be provided with a screen guard of the appropriate size and type. Control shall be provided by means of a switch installed where shown and of the following type and characteristics (state size, catalog number, rating, number of speeds, surface on flush).

9.61 Electric Heating

The use of electric heat is constantly growing, for applications and advantages are countless. Controls and protective devices are reliable, units are relatively compact and light in weight, installation and maintenance are simple, heat losses are restricted and gasses associated with conventional forms of open-flame heat are absent.

Unit heaters, infra-red lamps, all-metal radiant units, encased elements, heating cable and induction heating can be specified to advantage. It must be recalled, however, that the efficiency of any of these methods depends upon two primary factors: selection and application. The former is governed by the desired heat range, available space, characteristics of the material being heated and the designed purpose of the heating element being considered. The latter factor—application—will depend upon the proximity of the heater to the objective, the efficiency of surrounding insulation and heat lost through radiation, convection or conduction.

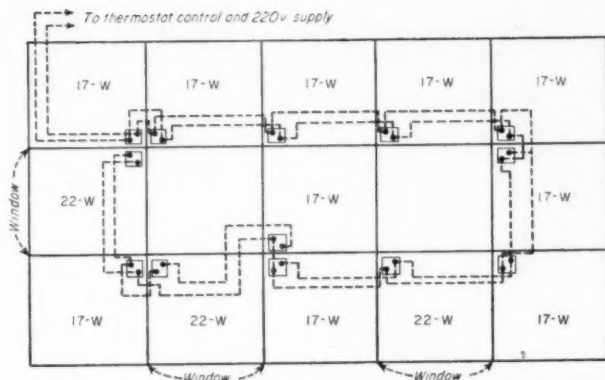
9.62 Unit Heaters

Electric self-contained space-heating units operate with either exposed or enclosed heating elements. Heat may emanate from low-temperature wires, high-temperature coils or radiant heating elements. These may be combined with fins or grills for faster dissipation of heat. Reflectors, deflectors, diffusers and forced-air fans may also be incorporated in the units. And a wide variety of mounting brackets, hangers and pedestals provide versatility for numerous installation methods.

Because of the vital function performed by unit heater motors, careful consideration should be devoted to wiring, control and accessory electric equipment. Such equipment includes: (1) *fused disconnect switches* for isolating wiring systems or sections thereof from the power source, providing instantaneous protection in cases of short circuiting or grounding; (2) *starters*, with or without integral overload protection, for connecting motors to power source; (3) *magnetic relays* for connecting a number of motors to power circuit, with a single set of automatic control instruments controlling several heating units; (4) *selector switches* for operating motors without resetting thermostats or limit controls; (5) *thermostats* to start motors when space temperatures drop below predetermined settings, and (6) *limit controls* for measuring temperatures or pressures of heating mediums, insuring that motors operate only when elements have reached their functional level, and that cold air will not be discharged.

Furnish and install at the points indicated on the drawings unit heaters having minimum Btu per hour capacities, air deliveries, discharges, velocities, maximum final air temperatures and motor rpm as specified in the accompanying schedule.

Unit heaters shall be of the propeller fan type, having — watts capacities, as manufactured by —, so designed as to permit direct suspension. They shall be controlled (manually, thermostatically).



Radiant heating panels can be installed in any desired pattern to give proper warmth to any room. In this ceiling plan, units over window areas have higher capacities than the other panels. Installation is operated at 220 volts and thermostatically controlled.

Electric motors shall be totally enclosed, with speeds not exceeding 1200 rpm. They shall be resiliently mounted to the unit to insure quiet operation, and adequate means shall be provided to prevent overheating under all operating conditions, including those periods when heating elements are coming up to operating temperatures prior to the operation of fans.

Unit heaters shall be provided with fan guards capable of supporting the weight of a man accidentally leaning against same.

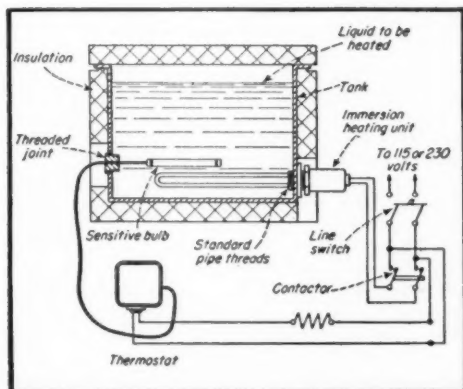
Propeller fans shall be designed for quiet operation, and shall be located in the streamlined air inlet to give most efficient operation. Adjustable, directional vanes shall be located on the discharge side.

Btu and cfm ratings shall be based on the standard code of the American Society of Heating and Ventilating Engineers.

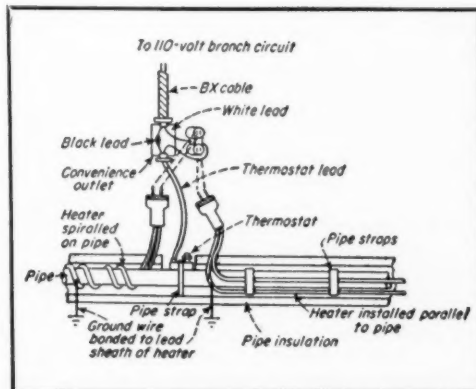
9.63 Radiant Heating

Furnish and install the radiant heating system shown on the plans, completely wired and in operating condition. The panels of the ratings shown shall be installed on the ceiling and fastened as shown.

From junction boxes in the branch circuit extend (armored cable, flexible conduit and wire) to the outlet box on the back of the heat panel or to special molding as directed. Load considerations shall be the same as for lighting circuits and no diversity factor shall be applied.



Immersion unit is controlled by magnetic switch and thermostat. Unit is sweated into threaded collar that screws into standard pipe threads.



Heating cable can be installed parallel to, or wound spirally around, pipe lines. Heat is confined by pipe insulation and controlled by means of a thermostat clamped directly to the pipe being heated.

10.1 Residential Wiring Specifications

The following design considerations and specifications are those particularly applicable to the wiring of residences and multiple occupancy dwellings in which provisions must be made for modern household appliances.

House wiring, in design and function, is unique among the construction features and services of the home. Plumbing and heating systems are complete when the buyer moves in and will remain substantially unchanged over many years. The structural characteristics are usually permanent for the life of the house. But the electrical system is only an array of concealed wires and outlets. The load which it will handle is represented only by the fixed lighting fixtures, plus the range and sometimes the water heater, if they come with the house. The completed house contains only the roots of an electrical utilization system which over the years will grow and branch out into all types of uses, some predictable, some still unknown.

Most of the load which the wiring system will serve will be connected after the buyer takes possession.

The home buyer invariably expects that the wiring system of a new home will accept and operate efficiently any or all of the electrical appliances currently advertised that he can afford to buy.

Service Entrance Capacity

The Code permits a minimum of No. 6 conductor for the service entrance to a single family dwelling. Most practical installation in even the smallest home will require larger conductors.

Planning the service entrance to a new home is one of the most important aspects of wiring system design. It is a major segment of the system cost and contains a substantial percentage of the copper requirements. The service capacity must be projected well beyond immediate requirements, or the owner is saddled with an expensive and wasteful replacement job as he purchases new appliances.

Contrary to popular belief, the design of residential services and feeders is more complicated than for many larger projects. Individual residential loads are highly variable in total demand from hour to hour, day to day and by seasons. Demand grows with

the individual purchase of new appliances, or better standards of illumination. Over many homes the fluctuation can be charted and projected with some accuracy. But at the time of building, for the individual home, the best design factors are imperfect.

The method of computing service entrance capacity given in Article 220 of the National Electrical Code is the only practical method so far devised that gives definite rationalization and reasonable results. It, however, is based on safety and may not be entirely adequate from an actual performance standpoint.

The Code method follows:

1. Square feet of floor area times 3 watts per-square-foot gives the design lighting load.
2. Add 1500 watts of miscellaneous appliance load.
3. Take 3,000 watts of the total at 100%.
4. Add 35% of the remainder.
5. This is the design lighting and small appliance load.
6. For an electric range (not over 12 kw rating) add 8,000 watts.
7. Add the rated watts of all fixed appliances.
8. Take 75% of the total fixed appliances and add to the range, lighting and small appliance totals.
9. Divide the total by 230 to obtain the minimum ampere capacity for the service conductors.

Some designers contend that the fixed appliance diversity should permit a lower demand factor; others insist, with considerable logic, that automatic appliances should be taken at full demand.

As a general consideration, a well designed wiring system should operate without interruption on any probable combination of loads. Overcurrent protection should not operate to limit the reasonable use of approved equipment in satisfactory working condition. On accidental overloads, or on equipment or cord failures, the resulting interruption should be limited in extent. For instance, failure of an iron cord should not shut down the food freezer or stop the washing machine.

Adequate branch circuit capacity is one of the least expensive conveniences which can be designed into the wiring system. In practical systems it acquires only a few additional panel

circuits or an additional load center panel plus a few feet of additional home runs. With proper layout little more cable or wire is required. For example, a strategically located panel may serve several full circuit outlets with no more cable than would be required to loop one circuit between them. The resulting benefit of adequate branch circuit capacity is to double or triple the effective trouble-free utility of the wiring system.

The following are practical circuit modifications which increase efficiency and utility:

1. *Multewire appliance circuits:* Kitchen and dining areas need at least two 20 amp appliance circuits to handle probable appliance groups. (A typical group which must operate efficiently at the same time is the toaster, grille and coffee maker. The connected load of these three devices may exceed 3 kw. Any two is nearly a full load for a single appliance circuit). A three wire common neutral circuit with each plug receptacle on alternate sides of the circuit gives a good measure of assurance against overloading.

2. *Full circuits to fixed appliances:* Modern automatic appliances in portions of their cycles often require currents near the full capacity of an appliance circuit. It is good practice to isolate such appliances on individual circuits. Typical appliances which ought to have full circuits are:

- Dishwasher—disposal unit
- Automatic washer
- Room air conditioner
- Ironer
- Bathroom or nursery heater

3. *Full circuit to appliance groups:* Some types of automatic appliances do not offer individual loads near circuit capacity, but should be isolated as a group to assure uninterrupted operation. These include the refrigerator, food freezer and heating plant. (Some local codes require an individual circuit to an automatic heating plant). The purpose of the separate circuit here is to avoid interruption as a result of overload or cord failures.

4. *Load center panel:* Economical circuiting for modern appliance loads usually requires the use of load center panels. Diversity consideration which cannot be applied to individual branch circuits can be used to advantage in feeder runs.

TABLE 1

Calculations for service entrance to a small one family dwelling with a floor area of 1200 square feet.

1200 sq ft at 3 watts per sq ft.....	3600w
Misc. appliance load.....	1500w
Total.....	5100w
3000 watts at 100% demand factor.....	3000w
2100 watts at 35% demand factor.....	735w
Total.....	3735w
Electric range.....	8000w
Total.....	11,735w
Fixed Appliance Load	
Water heater.....	3000w
Washer.....	700w
Dryer.....	4700w
Ironer.....	1700w
Dishwasher — disposal unit..	1800w
Room cooler.....	1500w
Food freezer.....	300w
Refrigerator.....	300w
Heating plant.....	300w
Total.....	14,300w
at 75% demand factor.....	10,725w
Total.....	22,460w
22,460 divided by 230 gives 97 amperes. Next nearest wire size for this capacity in type R wire is No. 1.	

5. *Circuit protection:* Many motor operated appliances take a momentary starting current which may exceed the rated circuit capacity. Under normal conditions these overloads are harmless and should not operate the overcurrent protection device. Circuits serving appliance circuits should be equipped with circuit breakers on time delay fuses. These devices are designed to pass momentary starting currents while still providing full protection against short circuits or sustained overloads.

Single-phase motors used in electrical appliances operate at relatively low power factor. In normal operation they may require currents considerably higher than would be indicated by dividing the rated watts by the voltage.

Service

Furnish and install the following service entrance where shown on the plans.

Service entrance conductors shall be 3 No. — with type — insulation (R, RW, T, RH, etc.) with a total capacity of — amperes.

Service entrance conductors shall be

- Service entrance cable (SE).
- Armored service entrance cable (ASE).
- Installed in — inch rigid conduit.
- Underground service entrance cable (USE).

in accordance with the rules and requirements of applicable codes and the rules of the utility company supplying the property.

Underground

From a point on the utility pole 4-inches above the upper conductor of the distribution lines adding 30 inches for drip loops and connections, provide a USE cable of the size specified to the service terminals of the service switch (meter box, service panel, etc.).

From a point on the pole 8 feet above grade provide a run of — inch rigid conduit down below grade with an elbow terminating at the level of the underground run. Provide insulating bushings at each end of the protective conduit run. The conduit shall be firmly attached to the pole with at least two approved pipe straps.

TABLE 2

Typical Residential Loads and Circuit Requirements

	Watts	Conductors	Circuit
Range.....	8,000	No. 6	50 amp Note 1
Water heater.....	3,000	No. 12	20 amp Note 2
Dishwasher.....	700	No. 12	20 amp Note 3
Disposal unit.....	500	No. 12	20 amp Note 3
Refrigerator.....	300	No. 12	20 amp Note 4
Freezer.....	300	No. 12	20 amp Note 4
Oil burner.....	300	No. 12	20 amp Note 4
Room air conditioner.....	1,700	No. 12	20 amp Note 5
Automatic washer.....	700	No. 12	20 amp Note 5
Ironer.....	1,750	No. 12	20 amp Note 5
Dryer.....	4,500	No. 10	30 amp Note 1
Bathroom heater.....	1,500	No. 12	20 amp Note 5
TV set.....	300	No. 12	20 amp Note 6
Hobby bench.....	1,800	No. 12	20 amp Note 5

- Special purpose heavy duty circuits and outlets required.
- Practices vary widely in different utility areas. For design consideration local rules should be consulted.
- An individual circuit to the dishwasher and disposal is recommended. Some dishwashers contain water heating elements.
- Automatic equipment should be isolated on a separate circuit. Some local codes require an individual circuit to the oil burner or stoker.
- Individual circuits are recommended for such heavy current appliances. Washers often approach circuit capacity in portions of the duty cycle.
- It is good practice to avoid connecting the TV set to circuits serving appliances with automatic on-off cycles.

Cable for the run up the pole shall be neatly coiled above the protective conduit for installation and connection by the utility. The utility will install the cable on the pole, seal the upper entrance to the protective conduit, enclose the cable in wood molding and make final connection to the distribution conductors.

a. Cable shall be buried to a depth of 30 inches (or below frost line). Where cable passes under driveways it shall be covered by 6-by 2-inch creosoted wood planking to a distance of 3 feet beyond each side of the driveway.

At the building end of the underground run the cable shall be enclosed in rigid conduit to a distance of 5 feet from the wall.

Where the cable enters the conduit at each end of the underground run the conduit shall be sealed with oakum and sealing compound. The seals shall be surrounded by 6 inches of sand in all directions before back filling.

b. Extend the service conductor in rigid conduit underground at a depth of — inches.

c. Extend the service conductor in approved (fiber, Transite, etc.) conduit underground from the pole to the building.

Panels

Panelboards are usually chosen from among many specially designed for residential service. The main switch and branch circuits may be enclosed within the same box. Some types take advantage of the "six circuit rule" and parallel the main and range units.

A common type is the "main, range and 8" with parallel 50-amp main and range circuits and 8 single pole branch circuits controlled by the main. For circuit breaker panels several manufacturers offer unit construction with interchangeable breakers. A few standardized stock parts and cabinets are assembled to meet a wide range of individual panelboard requirements.

Most residential wiring systems use a single panelboard. There is a trend however toward dividing the circuits among one or more additional panels which can be located advantageously near load centers.

The main service switch or panel must be located within three feet of the entrance of the service conductors. Additional panels may be located wherever convenience may indicate.

Service Switch

(Where separate service switch is installed, if no separate switch is installed see main panel below) Furnish and install where shown on plans as main service entrance switch approved for use on service entrance equipment. Switch shall be 2 pole — ampere (fused or circuit breaker) with neutral bus.

Main Panel

Furnish and install where shown on the plans a service entrance panel. The panel shall be equipped with — ampere mains and the following circuits. (List circuits and describe connection of main disconnects if more than one)

Panel shall be dead front type with overcurrent protection provided by

a. fuses

b. circuit breakers, (thermal, thermal magnetic, hydraulic magnetic)

(When panel is a service entrance panel) The main panel shall be approved for use as service entrance equipment.

From the entrance panel provide a feeder of 3 No. — conductors to the mains of the load center.

Wiring System

In single-family residences the method of wiring is usually determined by local ordinances or historical practice in the community. For multi-family dwellings, flats, and apartment houses, the wiring system employed usually follows commercial and institutional practice. The following specification is intended to apply to single-family dwellings or multi-family dwellings of similar construction and electrical consideration.

The six wiring systems most widely used in residential work are:

Knob and tube

Non-metallic sheath cable

Armored cable

Flexible conduit and wire

EMT and wire

Rigid conduit and wire

Combinations of methods are sometimes used as rigid conduit service and cable branch circuits or EMT on exposed work and armored cable concealed. All are approved by the National Electrical Code. Local ordinances in some communities may omit or restrict the use of some.

Branch Circuit Wiring

Wiring shall be — (specify wiring system) installed in accordance with the installation rules of the National Electrical Code and local rules and ordinances which apply. Wiring shall be installed firm and true, in an expert manner mechanically and electrically. Cutting and drilling of structural members shall be limited to that essential for proper installation.

Grounding conductor. (on knob and tube or non-metallic sheath cable systems) Circuits or cables serving grounding type receptacles shall contain a grounding conductor firmly connected at the outlet to the box (if metal) or to the grounding terminal of the device.

Outlet Boxes

Outlet boxes shall be steel (non-metallic) of an approved type. Each outlet box shall be of the proper size and type for the fixture or device accommodated. Outlet boxes shall be fastened firmly in place with hangers, brackets, or other methods particularly designed and approved for the purpose.

Outlet boxes shall be (a) knock-out type with separate cable clamps or connectors (locknuts and bushing, etc.), (b) equipped with integral cable clamps or connectors. Unused knockouts shall be left in place or provided with an approved closure.

Locknuts or connectors shall be set up tight to provide a firm mechanical and electrical connection.

Unless otherwise indicated, the following outlet boxes shall be used:

Ceiling Fixtures—4 in. octagonal 1½ inches deep

Bracket Fixtures—4 in. octagonal 1½ inches deep with 3 in. round ¾ inches deep plastic cover

Wiring Devices — Rectangular switch box, 3 in. deep gauged as required.

Where ceiling, bracket or device outlets serve as junction boxes or contain more than 6 (exclusive of fixture wires) conductors, they shall be 4 in. square 1½ in. deep with ¾ in. plaster cover appropriate for the fixture or device.

Outlet boxes for flush devices on 30- or 50-ampere circuits shall be 4 11/16 square 2½ in. deep with appropriate cover.

Branch Circuits

Furnish and install branch circuits from the panelboard (s) to the outlets shown on the plans or described in the outlet schedule.

Lighting

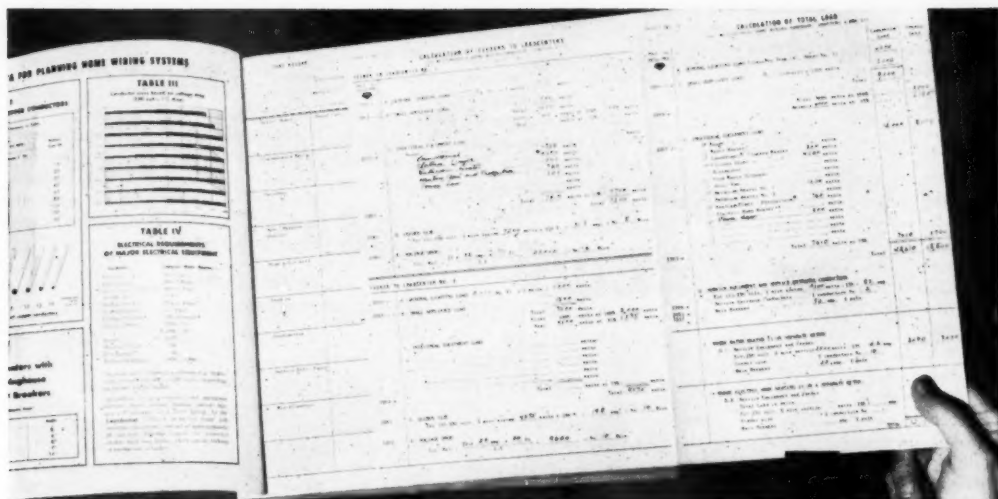
Lighting and plug receptacle circuits in areas other than the kitchen, laundry utility room, basement or porch shall be 2 wire No. 14 (No. 12) 15-ampere circuits. One circuit shall be provided for each 500 square feet or fraction thereof of floor area.

Appliance

Plug receptacles in the kitchen, laundry utility room, basement and porch other than those on special circuits shall be served by not less than 2 No. 12 20-ampere appliance circuits. A 3-wire circuit may be used with individual receptacles connected alternately to either side.

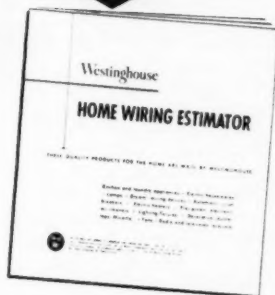
Isolating

Plug receptacles for the refrigerator and freezer and the outlet



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for connecting the heating plant shall be served by a separate No. 12 20-ampere appliance circuit. (In some communities Codes may require an individual circuit to the heating plant.)

Individual

Plug receptacles for connection of the following appliances shall be served by individual No. 12 20-ampere appliance circuits:

Automatic clothes washer

Electric dishwasher and disposal unit

Bathroom heater

Nursery heater

Room cooler

Attic fan

Hobby bench

Where practical, a heater outlet may be combined with a room cooler or attic fan outlet on the same circuit.

The outlet for connecting the electric clothes dryer shall be served by an individual 3 wire No. 10 circuit terminating in an approved 30-ampere 3-wire flush (surface) receptacle.

The outlet for connecting the electric range shall be served by a 3 wire No. 6 circuit terminating in an approved flush (surface) 50-ampere 3-wire receptacle.

The outlet for connecting the electric water heater shall be wired in accordance with the requirements of the local utility. (Local requirements vary depending upon metering provisions, permissible element capacities, etc. The utility rules should be consulted.)

Typical branch circuit schedule for a 1500 square foot residence with conventional electrical appliances.

Full Circuits

Electric sink	1-20 amp
Automatic washer	1-20 amp
Ironer	1-20 amp
Air conditioner (room type)	2-20 amp
Hobby bench	1-20 amp

Heavy Duty Circuits

Range	2-50 amp
Water heater	2-20 amp
Dryer	2-30 amp

Isolating Circuit

Ref.; Freezer; Oil

Burner 1-20 amp

Appliance Circuits

Small appliances 2-20 amp

Lighting Circuits

1500 square feet 3-15 amp

Wiring Devices

Furnish and install where shown on plans or noted in the outlet schedule the wiring devices indicated. Flush devices shall be of the best quality. (specify color) Plates shall be (composition, brass, etc.) and finished — (specify color or finish). Where more than one device is indicated at one location the devices shall be provided with one plate of the necessary size.

Switches

a. Furnish and install at each switch outlet a quiet operating tumbler type mercury switch, single pole, 3 way or 4 way as indicated.

b. Furnish and install at each switch outlet a tumbler type switch T rated, single pole, 3 way or 4 way as indicated.

c. Furnish and install at each switch outlet a press type, sequence on-off switch.

Switches shall be provided with terminal screws or connectors to firmly terminate up to No. 10 conductors.

Receptacles

Furnish and install at receptacle outlets on lighting circuits a (duplex, triplex) plug receptacle, 15-ampere, 120-volt for parallel blade attachment caps.

Furnish and install at receptacle outlets on appliance circuits a grounding type duplex plug receptacle, 15-ampere, 120-volt designed to handle either parallel blade or grounding type attachment caps.

Receptacles and plates located outdoors shall be single weather-proof type with screw cap closure.

The receptacle contacts shall be designed to grip both sides of each blade. Terminal screws or connectors shall be designed to firmly terminate up to No. 10 solid conductors.

Multi-outlet Assemblies

Multiple outlet assemblies shall be furnished and installed where shown on the plans or indicated in the outlet schedule. Each section shown shall be continuous with outlets spaced — in. apart.

On lighting circuits the assembly shall be designed to take standard parallel blade attachment caps.

a. They shall be two wire type with switch control as shown or described on the outlet schedule.

b. They shall be the divided circuit type with the upper positions switched as shown.

On appliance circuits the assembly shall be grounding type designed to take either standard parallel blade attachment caps or grounding type attachment caps on any outlet.

Surface Devices,

Cable Installation

Where wiring is run exposed in basement, garage and attic space, surface type wiring devices shall be used as made by — or approved equal. Devices shall be mounted firmly as recommended by the manufacturer and wiring securely installed. Cable shall be independently fastened in place within six inches of terminal connections.

Surface devices, raceway installation. When wiring is run exposed as in basement, garage and attic space, outlets, boxes and devices shall be suitable for exposed work and shall present a neat and workmanlike appearance.

a. Boxes shall be pressed steel type with rounded corners and fitted covers designed for the devices installed. Raceways shall be installed square. (rigid conduit, EMT)

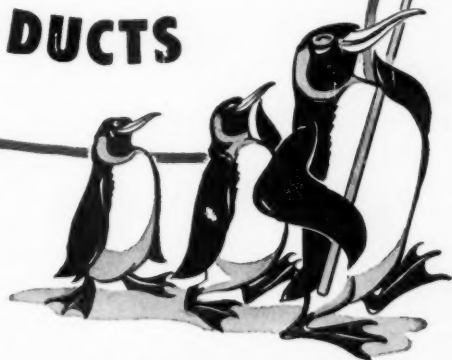
b. Raceways shall be surface type steel raceways installed square with elbows, boxes, connectors and closures designed specifically for use with the raceway and of the same manufacture.

Kitchen fan. Furnish and install when shown on plans as kitchen exhaust fan Catalog No. — as made by — or approved equal. Fan shall be designed to handle not less than — cu. ft. of air per minute. External opening shall be provided with (specify type of louver, closure, or vent). Fan shall be controlled by (specify type and location of switch).

Relay Switching

Switch control of the outlets noted on the plans shall be provided by a low voltage remote control system as made by — or approved equal. (See Relay Switching in master specifications for detailed specifications.)

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Daily Load Factor—75%
Earth Temp. ambient—20 C.

	Transite	Other
Total Therm. Res. to Dielectric Loss (C watts/ft.)	5.66	6.17
Total Therm. Res. to Copper Loss (C watts/ft.)	4.44	4.95
Temp. Rise from Dielectric loss (C)	1.9	2.1
Allowable Rise for Copper loss (C)	59.1	58.9
Allowable Watts per ft. cable	4.44	3.96
Allowable Current—(Amps. per cdr.)	386.	365.
Allowable Current—(Relative %)	105.6	100.

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11.1 Data Tables

NUMBER OF CONDUCTORS IN CONDUIT OR TUBING

Rubber Covered, Types RF-32, RUF, R, RH, RW, RU, and RUW
Thermoplastic, Types TF, T and TW
One to Nine Conductors

Size AWG MCM	Number of Conductors in One Conduit or Tubing								
	1	2	3	4	5	6	7	8	9
18	1	1	1	1	1	1	1	1	1
16	1	1	1	1	1	1	1	1	1
14	1	1	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1	1	1
6	1	1	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1
00	1	1	1	1	1	1	1	1	1
000	1	1	1	1	1	1	1	1	1
0000	1	1	1	1	1	1	1	1	1
250	1	1	1	1	1	1	1	1	1
300	1	1	1	1	1	1	1	1	1
350	1	1	1	1	1	1	1	1	1
400	1	1	1	1	1	1	1	1	1
500	1	1	1	1	1	1	1	1	1
600	2	2	2	2	2	2	2	2	2
700	2	2	2	2	2	2	2	2	2
750	2	2	2	2	2	2	2	2	2
800	2	2	2	2	2	2	2	2	2
900	2	2	2	2	2	2	2	2	2

* Where a service run of conduit or electrical metallic tubing does not exceed 50 feet in length and does not contain more than the equivalent of two quarter bends from end to end and two No. 4 insulated and one No. 4 bare conductors may be installed in 1-inch conduit or tubing.

NUMBER OF CONDUCTORS IN CONDUIT OR TUBING

Lead-Covered Types RL and RHL-600 V..

Size AWG MCM	Number of Conductors in One Conduit or Tubing											
	Single Conductor Cable				2-Conductor Cable				3-Conductor Cable			
	1	2	3	4	1	2	3	4	1	2	3	4
14	1	1	1	1	1	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1	1	1	1	1	1
6	1	1	1	1	1	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1
0	1	1	1	1	1	1	1	1	1	1	1	1
00	1	1	1	1	1	1	1	1	1	1	1	1
000	1	1	1	1	1	1	1	1	1	1	1	1
0000	1	1	1	1	1	1	1	1	1	1	1	1
250	1	1	1	1	1	1	1	1	1	1	1	1
300	1	1	1	1	1	1	1	1	1	1	1	1
350	1	1	1	1	1	1	1	1	1	1	1	1
400	1	1	1	1	1	1	1	1	1	1	1	1
500	1	1	1	1	1	1	1	1	1	1	1	1
600	2	2	2	2	2	2	2	2	2	2	2	2
700	2	2	2	2	2	2	2	2	2	2	2	2
750	2	2	2	2	2	2	2	2	2	2	2	2
800	2	2	2	2	2	2	2	2	2	2	2	2
900	2	2	2	2	2	2	2	2	2	2	2	2

NUMBER OF CONDUCTORS IN CONDUIT OR TUBING

More Than Nine Conductors
Rubber-Covered Types RF-32, RUF, R, RH, RW, RU, RUW, RW
Thermoplastic Types TF, T, and TW

Size AWG	Maximum Number of Conductors in Conduit or Tubing						
	1/4 Inch	1/2 Inch	3/4 Inch	1 Inch	1 1/2 Inch	2 Inch	3 Inch
18	12	20	35	49	80	115	176
16	10	17	30	41	68	97	150
14		10	18	25	40	59	90
12			15	21	35	50	77
10			13	17	29	41	64
8				10	17	25	38
6					15	23	23

DIMENSIONS OF RUBBER-COVERED AND THERMOPLASTIC-COVERED CONDUCTORS

Size AWG MCM	Types RF-32, R, RH, RW		TF, T, TW, RU** RUF, RUW	
	Approx. Diam. Inches	Approx. Area Sq. Ins.	Approx. Diam. Inches	Approx. Area Sq. Ins.
18	.146	.0167	.106	.0088
16	.158	.0196	.118	.0109
14	2/64 in. .171	.0230	.131	.0135
12	3/64 in. .204*	.0327*		
10	2/64 in. .188	.0278	.148	.0172
8	3/64 in. .221*	.0384*		
6	.242	.0460	.168	.0224
4	.311	.0760	.228	.0408
3	.397	.1238	.323	.0819
2	.452	.1605	.372	.1087
1	.481	.1817	.401	.1263
0	.513	.2067	.433	.1473
00	.588	.2715	.508	.2027
000	.629	.3107	.549	.2367
0000	.675	.3578	.595	.2781
250	.727	.4151	.647	.3288
300	.785	.4840	.705	.3904
350	.868	.5917	.788	.4877
400	.933	.6837	.843	.5581
450	.985	.7620	.895	.6291
500	1.032	.8365	.942	.6969
600	1.119	.9834	1.029	.8316
700	1.233	1.1940	1.143	1.0261
750	1.304	1.3355	1.214	1.1575
800	1.339	1.4082	1.249	1.2252
850	1.372	1.4784	1.282	1.2908
900	1.435	1.6173	1.345	1.4208

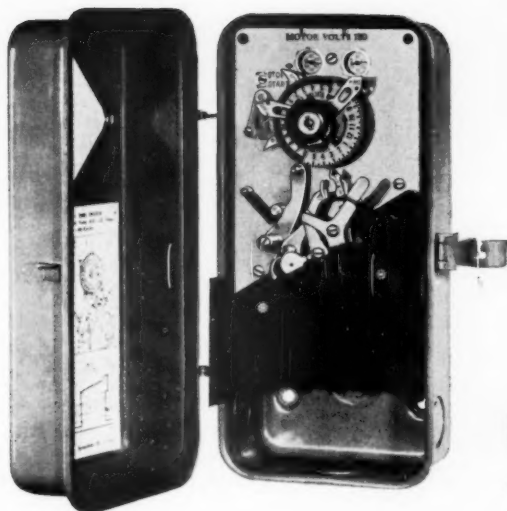
*The dimensions of Type RW wire. Also, these dimensions to be used for new work in computing size of conduit or tubing for combinations of wires not shown in table 4.

**No. 14 to No. 2, solid; No. 6 and larger, stranded.

DIMENSIONS OF LEAD-COVERED CONDUCTORS

Types RL, RHL, and RUL

Size AWG-MCM	Single Conductor		Two Conductor		Three Conductor	
	Diam. Inches	Area Sq. Ins.	Diam. Inches	Area Sq. Ins.	Diam. Inches	Area Sq. Ins.
14	.28	.062	.28 x .47	.115	.59	.273
12	.29	.066	.31 x .54	.146	.62	.301
10	.35	.096	.35 x .59	.180	.68	.363
8	.41	.132	.41 x .71	.255	.82	.528
6	.49	.188	.49 x .86	.369	.97	.738
4	.55	.237	.54 x .96	.457	1.08	.916
2	.60	.283	.61 x 1.08	.578	1.21	1.146
1	.67	.352	.70 x 1.23	.756	1.38	1.49
0	.71	.396	.74 x 1.32	.859	1.47	1.70
00	.76	.454	.79 x 1.41	.980	1.57	1.94
000	.81	.515	.84 x 1.52	1.123	1.69	2.24
0000	.87	.593	.90 x 1.64	1.302	1.85	2.68
250	.98	.754			2.02	3.20
300	1.04	.85			2.15	3.62
350	1.10	.95			2.26	4.02
400	1.14	1.02			2.40	4.52
500	1.23	1.18			2.59	5.28



SANGAMO HEAVY DUTY TIME SWITCH

Sangamo Heavy Duty Time Switches are specifically designed to meet the needs of industrial applications—a considerable extra margin of dependability is provided at only slightly higher cost. They are available for practically any conceivable industrial application from the simplest "on" and "off" operation to complex schedules involving a number of operations daily.

SANGAMO

the time switch
with the

Automatic Memory

will often solve problems
of daily sequence timing in
INDUSTRIAL PROCESSES

Wherever there is the possibility of repetitive electrical control functions being omitted or delayed due to human forgetfulness, the automatic memory of Sangamo Time Switches can be depended upon to perform such functions with absolute certainty. These switches are a real "find" for factory operations where power and lighting circuits are to be operated before the workshift begins, or after it ends. A few applications where Sangamo Time Switches can be used for automatic time control of industrial processes are listed below.

INDUSTRIAL APPLICATIONS

For daily pre-heating:

- Lead pots for solder operations.
- Zinc for injection molding.
- Type metal in type foundries.
- Dies in plastic molding presses.
- Glue in woodworking shops.
- Tanks for galvanize dipping.
- Electric ovens and furnaces.
- Infra-red paint dryers.
- Electronic testing equipment.
- Soldering irons on assembly lines.

For daily circuit control:

- Yard floodlights.
- Runway and hall lights.
- Electric factory signs.
- Pumps, compressors.
- Water softeners.
- Mixing equipment.
- Electric doors and gates.
- Air conditioning.
- Alarm systems.
- Exhaust fans.
- Electric valves.
- Two-level thermostats.

SANGAMO ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

Get the full story—write for Catalog No. 1010-A today.



5731-4

11.1 DATA TABLES (Continued)

COMBINATION OF CONDUCTORS
Per Cent Area of Conduit or Tubing Occupied by
Conductors

	Number of Conductors				
	1	2	3	4	Over 4
Conductors (not lead covered) . . .	53	31	43	40	40
Lead-covered conductors	55	30	40	38	35
For rewiring existing raceways for increased load where it is impracticable to increase the size of the raceway due to structural conditions	60	40	50	50	50

ALLOWABLE CURRENT-CARRYING CAPACITIES OF
INSULATED CONDUCTORS IN AMPERES

Not More Than Three Conductors in Raceway or Cable

(Based on Room Temperature of 30 C, 86 F.)

Size AWG MCM	Rubber Type R Type RW Type RUW Type RUW 14-2	Rubber Type RH	Paper Thermo- plastic Asbestos Type TA Var-Cam Type V Asbestos Var-Cam Type AVB	Asbestos Var-Cam Type A Type A Type A Type A	Impreg- nated Asbestos Type AI (14-8) Type AIA	Asbestos Type A (14-8) Type AA
	Thermo- plastic Type T Type TW					
14	15	15	25	30	30	30
12	20	20	30	35	40	40
10	30	30	40	45	50	55
8	40	45	50	60	65	70
6	55	65	70	80	85	95
4	70	85	90	105	115	120
3	80	100	105	120	130	145
2	95	115	120	135	145	165
1	110	130	140	160	170	190
0	125	150	155	190	200	225
00	145	175	185	215	230	250
000	165	200	210	245	265	285
0000	195	230	235	275	310	340
250	215	255	270	315	335	....
300	240	285	300	345	380	....
350	260	310	325	390	420	....
400	280	335	360	420	450	....
500	320	380	405	470	500	....
600	355	420	455	525	545	....
700	385	460	490	560	600	....
750	400	475	500	580	620	....
800	410	490	515	600	640	....
900	435	520	555	....	....	....
1000	455	545	585	680	730	....
1250	495	590	645	....	....	....
1500	520	625	700	785	....	....
1750	545	650	735	....	....	....
2000	560	665	775	840	....	....

CORRECTION FACTOR FOR ROOM TEMPERATURES
OVER 30 C, 86 F.

C.	F.	.82	.88	.90	.94	.95	....
40	104	.82	.88	.90	.94	.95	....
45	113	.71	.82	.85	.90	.92	....
50	122	.58	.75	.80	.87	.89	....
55	131	.41	.67	.74	.83	.86	....
60	140	....	.58	.67	.79	.83	.91
70	158	....	.35	.52	.71	.76	.87
75	167	....	....	.43	.66	.72	.86
80	176	....	....	.30	.61	.69	.84
90	194	....	....	....	.50	.61	.80
100	212	....	....	....	....	.51	.77
120	248	....	....	....	....	....	.69
140	284	....	....	....	....	....	.59

DIMENSIONS OF CONDUIT OR TUBING

Size	Internal Diameter Inches	Area Square Inches	Size	Internal Diameter Inches	Area Square Inches
1/2	.622	.30	3	3.068	7.38
3/4	.824	.53	3 1/2	3.548	9.90
1	1.049	.86	4	4.026	12.72
1 1/4	1.380	1.50	4 1/2	4.506	15.95
1 1/2	1.610	2.04	5	5.047	20.00
2	2.067	3.36	6	6.065	28.89
2 1/2	2.469	4.79			

ALLOWABLE CURRENT-CARRYING CAPACITIES OF
INSULATED CONDUCTORS IN AMPERES

Single Conductor in Free Air

(Based on Room Temperature of 30 C, 86 F.)

Size AWG MCM	Rubber Type R Type RW Type RUW Type RUW 14-2	Rubber Type RH	Thermo- plastic Type T Type TW	Asbestos Var-Cam Type V Type AVB	Asbestos Type A (14-8) Type AIA	Impreg- nated Asbestos Type AI (14-8) Type AIA	As- bestos Type A (14-8) Type AA	Slow Burning Type SB	Weather- proof Type WP
14	20	20	30	40	40	45	30		
12	25	25	40	50	50	55	40		
10	40	40	55	65	70	75	55		
8	55	65	70	85	90	100	70		
6	80	95	100	120	125	135	100		
4	105	125	135	160	170	180	130		
3	120	145	155	180	195	210	150		
2	140	170	180	210	225	240	175		
1	165	195	210	245	265	280	205		
0	195	230	245	285	305	325	235		
00	225	265	285	330	355	370	275		
000	260	310	330	385	410	430	320		
0000	300	360	385	445	475	510	370		
250	340	405	425	495	530	....	410		
300	375	445	480	555	590	....	460		
350	420	505	530	610	655	....	510		
400	455	545	575	665	710	....	555		
500	515	620	660	765	815	....	630		
600	575	690	740	855	910	....	710		
700	630	755	815	940	1005	....	780		
750	655	785	845	980	1045	....	810		
800	680	815	880	1020	1085	....	845		
900	730	870	940	....	....	....	905		
1000	780	935	1000	1165	1240	....	965		
1250	890	1065	1130	....	....	....	....
1500	980	1175	1260	1450	....	....	1215		
1750	1070	1280	1370	....	....	....	....
2000	1155	1385	1470	1715	....	....	1405		

CORRECTION FACTOR FOR ROOM TEMPERATURES
OVER 30 C, 86 F.

C.	F.	.82	.88	.90	.94	.95	....
40	104	.82	.88	.90	.94	.95	....
45	113	.71	.82	.85	.90	.92	....
50	122	.58	.75	.80	.87	.89	....
55	131	.41	.67	.74	.83	.86	....
60	140	....	.58	.67	.79	.83	.91
70	158	....	.35	.52	.71	.76	.87
75	167	....	....	.43	.66	.72	.86
80	176	....	....	.30	.61	.69	.84
90	194	....	....	....	.50	.61	.80
100	212	....	....	....	....	.51	.77
120	248	....	....	....	....	....	.69
140	284	....	....	....	....	....	.59



when you want a direct answer

... to your direct current motor problems, look to your nearby Fairbanks-Morse Electric Motor Specialist.

He is technically qualified to help you select the equipment exactly suited to your D.C. needs.

Whether you are interested in a D.C. or A.C. motor ... one or a thousand—one type and size, or a variety of types and sizes ... you'll find that motors carrying

the Fairbanks-Morse Seal are designed and built to your most rigid requirements.

When you look for electric motors—for standard or unusual applications—*always* look for the Fairbanks-Morse Seal. For over 120 years it has stood for the finest in manufacturing integrity to *all* industry. Fairbanks, Morse & Co., Chicago 5, Illinois.



FAIRBANKS-MORSE

a name worth remembering when you want the best

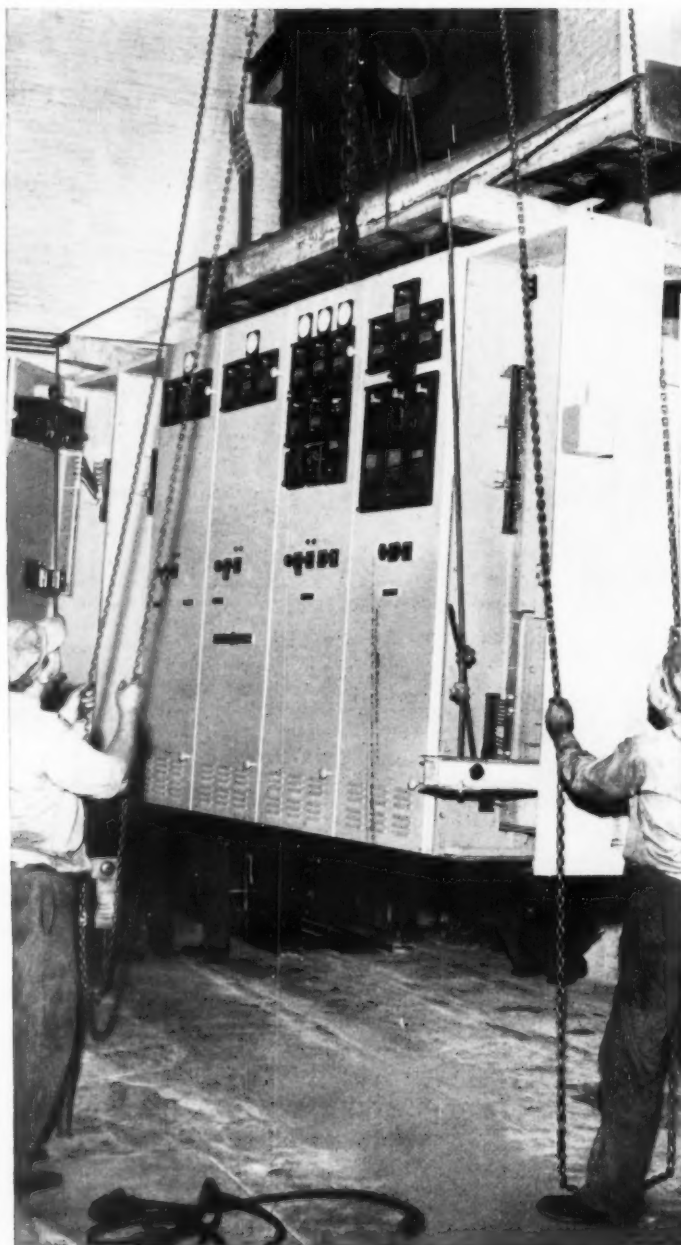
DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • PUMPS • SCALES
HOME WATER SERVICE EQUIPMENT • RAIL CARS • FARM MACHINERY • MAGNETOS

POWER LOAD DATA

Appliance, Device or Machine	Domestic		Commercial—Industrial		Appliance, Device or Machine	Domestic		Commercial—Industrial	
	Watts	Horsepower	Watts	Horsepower		Watts	Horsepower	Watts	Horsepower
	From To	From To	From To	From To		From To	From To	From To	From To
LIGHTING EQUIPMENT									
Airport Floods			240—3000		Exhalers		1/4—1/4		10—40
Airport Landing Lights			to 1 Kw.		Exercises		1/6—1/4		1/6—1/4
Blue Printing			3—10 Kw.		Extractors Juice		1/10—1/4		1/10—1/4
Bondedlights, Prof. Stage, per ft.			200—2000		Extractors Steam Laundry				
Bondedlights, Schools, per ft.			100—500		Fans Bucket & Desk	30—100		30—100	
Cove, Strips, per ft.	20—200		20—500		Fans Ceiling	80—125		80—125	
Exit Signs			40—150		Fans Pedestal	125—300		125—300	
Floodlights, Outdoor	60—500		200—2000		Fans Ventilating 10-in.	35—45		35—45	
Floodlights, Window			100—1000		Fans Ventilating 12—24 in.		1/40—1/4		1/40—1/4
Floodlights, Prof. Stage, per ft.			100—1000		Fans Ventilating 30-in. & up				3/8—3/4
Footlights, Schools, per ft.			100—300		Flasher, Sign Switch Drive		1/8 up		1/8 up
Infrared lamps, per lamp			250—1000		Freezing Food		1/90—1/4		1/6—3/4
Luminaires (Commercial Lighting Fixtures)	100—300		100—up		Freezers, Ice Cream		1/90—1/4		1/4—1
Luminous Tubing (Cold Cathode) per ft			5—10		Grinders, Coffee				1—5
Operating Rooms (Hospital)	1—10 Kw.		1—5 Kw.		Grinders, Meat				1 1/2—3
Photostat Machines			1—3 Kw.		Hoists, Ash & Cinder				6—10
Projection, Amateur Movie	500—750				Hoists, Trunk 1-ton				1—3
Projection, Amateur Movie and Sound	650—1250				Hoists, Warehouse Loading				
Projection, Prof. Movie			1500—3500	1/4—1	Lathes, Home Shop		1/8—1/2		1—3
Projection, Visual Lecturing			400—1000		Machines (Floor) Sending		1/8—1/2		1—5
Reflector, Stage, per ft.			30—150		Machines (Floor) Terrazzo		1/8—1/2		1/4—1
Reflector, Show Window, per ft.			100—750		Machines (Floor) Waxing		1/8—1/2		1/4—1
Spotlights Ball Room	100—500		100—2000		Machines Sewing		1/50—1/20		1/20—1/10
Spotlights Projection Booth			2750—3300		Machines Office, Adding		1/8—1/3		1/10—1/2
Spotlights Stage or Balcony Rail			200—1500		Machines Office, Addressing		1/10—1/2		1/10—1/2
Spotlights Show Windows			100—1000		Machines Office, Billing		1/10—1/2		1/10—1/2
Spotlights Statuary (Residence)	25—300				Machines Office, Bookkeeping		1/10—1/4		1/10—1/4
Stairlamps, per ft.	10		20		Machines Office, Computing		1/20		—1/30
Vapor, Mercury, High Intensity			250—3000		Machines Office, Dictation		1/10—1/6		1/10—1/6
ELECTRICALLY HEATED EQUIPMENT									
Blackens	50—100				Machines Office, Record Shaving		3/30—1/10		3/30—1/10
Boilers	1000—1500				Machines Office, Sealing & Stamping		1/2—20		1/2—20
Coolers	100—425				Mangles Laundry	30—100		30—100	
Cooking Food	195—1000				Mixer, Beverage		1/10—1/4		1/2—20
Dishes, Chafing	160—660				Mixer, Dough		1/10—1/4		1/2—20
Driers, Clothes	1500—5000				Mixer, Fruit		1/3—1/2		1/3—1
Driers, Hair	200—550			1/2	Mowers Lawn	50—200		50—200	
Driers, Deep Fat	1000		300—1200		Musical Instruments, Phonograph		1/20—1/8		1/20—1/4
Heaters, Air	4—9 Kw.		1—9 Kw.		Pumps Boiler Feed		1—5		1/30—1/4
Heaters, Immersion Type	150—1000		4—9 Kw.		Pumps Brine				3—20
Heaters, Organ Chamber	1—3 Kw.		200—2500		Pumps Drinking Water Circ.				1/8—5
Heaters, Permanent Wave Mach			9—10 Kw.		Pumps Fire Protection				20—150
Heaters, panel per sq. ft.	17—50		2—4 Kw.		Pumps Fuel		1/8—1		1/4—3
Heaters, Soil per 60-ft. & 120-ft. Lengths	400—800		17—50		Pumps Household Water				1/2—2
Heaters, Space Elements	1—3 Kw.		1—3 Kw.		Pumps Milling Machines		1/6—1		1/4—5
Heat Pumps					Pumps, Pool & Illum. Fountain				7 1/2—25
Heaters, Tank Type Water					Pumps, Roof Storage Tank				1/4—3
Humidifiers, Portable Room					Pumps, Sump		1/6		1/4—3
Humidifiers, Clothes					Pumps, Vacuum				2—5

[illegible]

Ohio plant avoids shutdowns with



THE G-E LOAD-CENTER SYSTEM
that provides reliable power
for Gardner Board & Carton Co.

3000-KVA.
13.2 KV/4.16 KV
TRANSFORMER CON-
NECTED TO UTILITY
LINES

5000-KVA.
4160 V/480 V
TRANSFORMER TO STEP
UP VOLTAGE OF EXIST-
ING GENERATOR

METAL-CLAD SWITCHGEAR

STOCK PREPARATIONS
UNIT SUBSTATION
3000-KVA. DOUBLE ENDED

STOCK PREPARATIONS
UNIT SUBSTATION
9000-KVA. DOUBLE ENDED

MACHINE UNIT SUB.
1500 KVA

MACHINE UNIT SUB.
1500 KVA

CARTON PLANT
UNIT SUBSTATION
750 KVA

RETAIL BOX PLANT
UNIT SUBSTATION
500 KVA

(For other details, see photos
and story on opposite page.)

G-E FACTORY-ASSEMBLED POWER EQUIPMENT IS EASY TO INSTALL. HERE MEN LOWER MAIN SWITCHGEAR SECTION INTO PLACE.

G-E load-center power system



Like many other growing plants, the Gardner Board and Carton Co. found they needed more power. They realized, too, a pressing need for more protection against power-failure shutdown than they had with their old-type 480-volt distribution system.

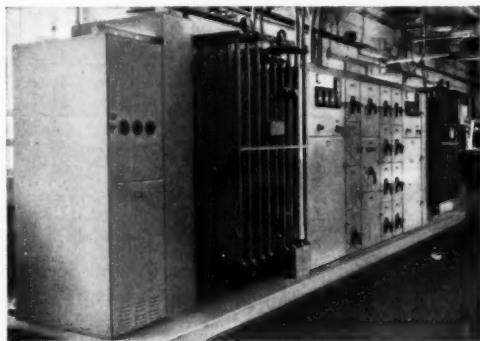
How they did it: With the help of General Electric engineers, Gardner completely replaced their old 480-volt system with a modern 4160-volt G-E load-center system. Compact, metal-enclosed unit substations now give them plenty of power—and plenty of protection against power shutdowns too. A secondary-selective system provides duplicate sources of power for substations supplying the most vital plant loads. Metal-enclosure of all live parts—and modern breakers with plenty of interrupting capacity—give further protection both for production and for plant personnel.

Improves Voltage—Saves Copper—Flexible for Future By taking high-voltage power directly to load centers, long secondary circuits are avoided, and plant voltage improved. The tons of extra copper that would have been required to expand the old 480-volt system were saved. And the plant electric system now has great flexibility for the future. Additional substations can be added easily, quickly, economically. Existing ones can be easily moved to follow load shifts.

For further information on G-E engineered load centers, call on your local G-E sales representative, or write for GEA-3592, General Electric Company, Schenectady 5, N. Y.

G-E "Project Co-ordination" praised by Chief Engineer

"Many costly man-hours were saved for us by G-E over-all co-ordination," says Arthur Harvey, Chief Engineer of Gardner Board and Carton Co. "From planning to final installation, G-E co-ordinated all equipment and delivery details whereas Gardner men installed the equipment. The effect on our production during this period was negligible." In photo above, Mr. Harvey discusses over-all plan submitted by General Electric with Mr. J. M. Popp, G-E sales engineer. A simple outline of this plan is shown in chart on opposite page.



Compact Double-ended Load-Center Unit installed close to load. Ratings: 3000 kva, 4160/480 v. Drawout breakers are easy to inspect, have plenty of interrupting capacity. Note G-E "Interlocked Armor" cables, which provide metal-enclosed circuits with lower material and installation costs.

GENERAL  ELECTRIC

521-78

11.1 DATA TABLES (CONTINUED)

CONDUCTOR SIZES AND OVERCURRENT PROTECTION FOR MOTORS

The values shown for running protection in Columns 5 and 6 must be modified if nameplate full load current values are different. Conductor sizes shown in Columns 2 and 3 may be smaller for certain motors. The current values shown in Columns 5 and 6 must be reduced by 8 per cent for all motors other than open type motors marked to have a temperature rise not over 40 degrees C.

Col. No. 1	Minimum size conductor in raceways For conductors in air or for other insulations see tables 1 and 2		For Running Protection of Motors		Maximum Allowable Rating or Setting of Branch Circuit Protective Devices		With Code Letters		With Code Letters	
	Type R		Maximum rating of non- adjustable protective devices	Maximum setting of adjustable protective device	With Code Letters Single-phase and squirrel cage and syn- chronous. Full voltage, resistor and reactor starting. Code letters F to R inc.	With Code Letters Single-phase and squirrel cage and synchronous. Full voltage, resistor or reactor starting. Code letters B to E inc. Auto-transformer starting. Code letters F to R inc.	With Code Letters Squirrel cage and synchronous Auto-transformer starting. Code letters B to E inc.	With Code Letters Squirrel cage and synchronous Auto-transformer starting. Code letters B to E inc.	With Code Letters All motors. Code letter A.	Without Code Letters DC and wound-rotor motors
	Type T	Type RH								
	2	3	4	5	6	7	8	9	10	
1	14	14	2	1.25	15	15	15	15		
2	14	14	3	2.50	15	15	15	15		
3	14	14	4	3.75	15	15	15	15		
4	14	14	6	5.0	15	15	15	15		
5	14	14	8	6.25	20	15	15	15		
6	14	14	9	7.50	20	15	15	15		
7	14	14	10	8.75	25	20	15	15		
8	14	14	10	10.0	25	20	20	15		
9	14	14	12	11.25	30	25	20	15		
10	14	14	15	15.50	30	25	20	15		
11	14	14	15	13.75	35	30	25	20		
12	14	14	15	15.00	40	30	25	20		
13	12	12	20	16.25	40	35	30	20		
14	12	12	20	17.50	45	35	30	25		
15	12	12	20	18.75	45	40	30	25		
16	12	12	20	20.00	50	40	30	25		
17	10	10	25	21.25	60	45	35	30		
18	10	10	25	22.50	60	45	40	30		
19	10	10	25	23.75	60	50	40	30		
20	10	10	25	25.0	60	50	40	30		
22	10	10	30	27.50	70	60	45	35		
24	10	10	30	30.00	80	60	50	40		
26	8	10	35	32.50	80	70	60	40		
28	8	10	35	35.00	90	70	60	45		
30	8	8	40	37.50	90	70	60	45		
32	8	8	40	40.00	100	80	70	50		
34	6	8	45	42.50	110	90	70	60		
36	6	8	45	45.00	110	90	80	60		
38	6	6	50	47.50	125	100	80	60		
40	6	6	50	50.00	125	100	80	60		
42	6	6	50	52.50	125	110	90	70		
44	6	6	50	55.0	135	110	90	70		
46	4	6	60	57.50	150	125	100	70		
48	4	6	60	60.0	150	125	100	80		
50	4	6	60	62.50	150	125	100	80		
52	4	6	70	65.0	175	150	110	80		
54	4	4	70	67.50	175	150	110	90		
56	4	4	70	70.00	175	150	120	90		
58	3	4	70	72.50	175	150	120	90		
60	3	4	80	75.00	200	150	120	90		
62	3	4	80	77.50	200	175	125	100		
64	3	4	80	80.00	200	175	125	100		
66	3	4	80	82.50	200	175	125	100		
68	3	4	90	85.00	225	175	150	110		
70	3	3	90	87.50	225	175	150	110		
72	3	3	90	90.00	225	200	150	110		
74	3	3	90	92.50	225	200	150	110		
76	3	3	100	95.00	250	200	175	125		
78	1	3	100	97.50	250	200	175	125		
80	1	3	100	100.00	250	200	175	125		
82	1	3	110	102.50	250	225	175	125		
84	1	3	110	105.00	250	225	175	125		
86	1	3	110	107.50	300	225	175	150		
88	1	3	110	110.00	300	225	200	150		
90	0	3	110	112.50	300	225	200	150		
92	0	3	125	115.00	300	250	200	150		
94	0	1	125	117.50	300	250	200	150		
96	0	1	125	120.00	300	250	200	150		
98	0	1	125	122.50	300	250	200	150		
100	0	1	125	125.00	300	250	200	150		
102	0	1	150	127.50	350	300	225	175		
104	0	0	150	130.00	350	300	225	175		
106	0	0	150	132.50	400	300	250	200		
108	0	0	175	135.00	400	350	250	200		
110	0	0	175	137.50	400	350	250	200		
112	0	0	175	140.00	450	350	300	225		
114	0	0	175	142.50	450	350	300	225		
116	0	0	200	145.00	450	400	300	225		
118	0	0	200	147.50	450	400	300	225		
120	0	0	200	150.00	450	400	300	225		
122	0	0	200	152.50	450	400	300	225		
124	0	0	200	155.00	450	400	300	225		
126	0	0	200	157.50	450	400	300	225		
128	0	0	200	160.00	450	400	300	225		
130	0	0	200	162.50	450	400	300	225		
132	0	0	200	165.00	450	400	300	225		
134	0	0	200	167.50	450	400	300	225		
136	0	0	200	170.00	450	400	300	225		
138	0	0	200	172.50	450	400	300	225		
140	0	0	200	175.00	450	400	300	225		
142	0	0	200	177.50	450	400	300	225		
144	0	0	200	180.00	450	400	300	225		
146	0	0	200	182.50	450	400	300	225		
148	0	0	200	185.00	450	400	300	225		
150	0	0	200	187.50	450	400	300	225		
152	0	0	200	190.00	450	400	300	225		
154	0	0	200	192.50	450	400	300	225		
156	0	0	200	195.00	450	400	300	225		
158	0	0	200	197.50	450	400	300	225		
160	0	0	200	200.00	450	400	300	225		
162	0	0	200	202.50	450	400	300	225		
164	0	0	200	205.00	450	400	300	225		
166	0	0	200	207.50	450	400	300	225		
168	0	0	200	210.00	450	400	300	225		
170	0	0	200	212.50	450	400	300	225		
172	0	0	200	215.00	450	400	300	225		
174	0	0	200	217.50	450	400	300	225		
176	0	0	200	220.00	450	400	300	225		
178	0	0	200	222.50	450	400	300	225		
180	0	0	200	225.00	450	400	300	225		
182	0	0	200	227.50	450	400	300	225		
184	0	0	200	230.00	450	400	300	225		
186	0	0	200	232.50	450	400	300	225		
188	0	0	200	235.00	450	400	300	225		
190	0	0	200	237.50	450	400	300	225		
192	0	0	200	240.00	450	400	300	225		
194	0	0	200	242.50	450	400	300	225		
196	0	0	200	245.00	450	400	300	225		
198	0	0	200	247.50	450	400	300	225		
200	0	0	200	250.00	450	400	300	225		
202	0	0	200	252.50	450	400	300	225		
204	0	0	200	255.00	450	400	300	225		
206	0	0	200	257.50	450	400	300	225		
208	0	0	200	260.00	450	400	300	225		
210	0	0	200	262.50	450	400	300	225		
212	0	0	200	265.00	450	400	300	225		
214	0	0	200	267.50	450	400	300	225		
216	0	0	200	270.00	450	400	300	225		
218	0	0	200	272.50	450	400	300	225		
220	0	0	200	275.00	450	400	300	225		
222	0	0	200	277.50	450	400	300	225		
224	0	0	200	280.00	450	400	300	225		
226	0	0	200	282.50	450	400	300	225		
228	0	0	200	285.00	450	400	300	225		
230	0	0	200	287.50	450	400	300	225		
232	0	0	200	290.00	450	400	300	225		
234	0	0	200	292.50	450	400	300	225		
236	0	0	200	295.00	450	400	300	225		
238	0	0	200	297.50	450	400	300	225		
240	0	0	200	300.00	450	400	300	225		
242	0	0	200	302.50	450	400	300	225		
244	0	0	200	305.00	450	400	300	225		
246	0									

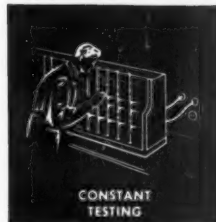
P&S WIRING DEVICES



EXPERIENCED
ENGINEERING



PRECISION
MANUFACTURING



CONSTANT
TESTING



ELECTRICAL WHOLESALE
DISTRIBUTION

To be sure
ORDER BY P&S
CATALOG NUMBER

Write for
a Catalog

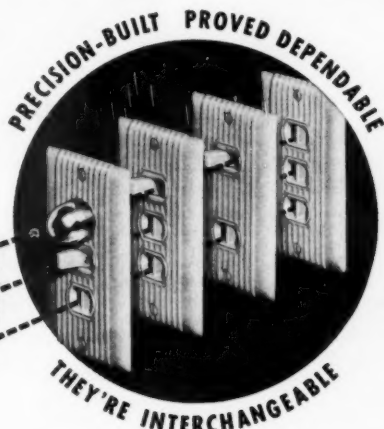
WIRE THE P&S. DESPARD WAY...

with the most modern,
the smartest-appearing
wiring devices on the
market today . . .

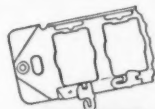
Here's How You Benefit

- Combinations of two or three compact, "specification" type P&S-Despard devices can be assembled under a single gang wall plate. You save on boxes — and on multi-gang wall plates.
- Practically any desired combination can be made up right on the job from a small stock of standard catalog numbers — no long waits for special combinations or special plates.
- P&S-Despard interchangeability makes it possible to give prompt service with a relatively small inventory — quicker turnover of your investment.
- The P&S-Despard Line gives you something to SELL — not just switches and outlets — but smart-appearing, compact combinations — modern, adequate wiring that looks good and is good.
- The P&S-Despard Line is not cheap — BUT IT IS ECONOMIC. You can install quality, "specification" type devices — T-rated switches, double grip outlets — for only a few cents more, due to the savings on boxes and wall plates. Where low cost is the prime consideration, use residential type switches (1391 Line). You'll find a one-gang installation of two 1391 switches will cost less than a two-gang installation using competitively priced strap type switches — and you'll have a better looking job.

Why Not Investigate the Possibilities of Wiring
the P&S-Despard Way?



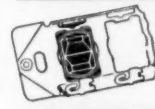
Assemble combinations
quick-as-a-flash with the
new Camstrap



1 OPEN CAM



2 INSERT DEVICE



3 CLOSE CAM

Write Dept. M. for
complete information.

P&S
TIME-TESTED
DEPENDABILITY

PASS & SEYMOUR, INC.

SOLVAY STATION

• SYRACUSE 9, NEW YORK

THE BEST COSTS LESS in the long run

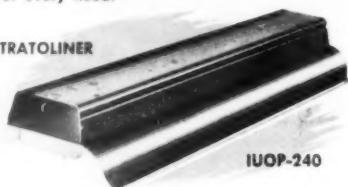
DEPEND ON

Leader

- for the
- newest in design
- finest in construction
- most complete selection

The Leader line of fine lighting fixtures is constantly being expanded to meet new needs in industry, business and a wide variety of other fields. Leader fixtures . . . whether they are long-established favorites or sparkling newcomers . . . offer the latest in styling, precision engineering, and finest quality construction, together with outstanding ease of installation and servicing. Electrical contractors everywhere know they can depend on Leader to furnish the right light for every need.

The STRATOLINER

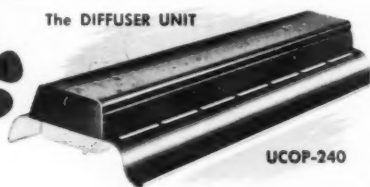


IUOP-240

Leader's STRATOLINER offers everything desired in a heavy-duty, all-steel industrial fluorescent fixture. Durable, strongly built, neat in appearance, easily serviced. Models for 2, 3 or 4 40-watt lamps or 2 85-watt lamps, in open or closed end styles. Choice of high-gloss baked enamel or porcelain enamel reflectors (RLM approved.)



The DIFFUSER UNIT



UCOP-240

Leader's new DIFFUSER unit has the same sturdy construction as the "Stratoliner," except that the DIFFUSER provides a 75% indirect lighting component. This is desirable in many industrial installations, to modify the contrast between brightly lighted work areas and dark upper areas. Available for 2 or 3 40-watt lamps in open end style. Reflector in choice of high-gloss baked enamel or porcelain enamel.

A wide variety of other industrial fluorescent fixtures are available, including Slimline models for 2, 3 or 4 lamps in 72" or 96" length.

LEADER INCANDESCENT UNITS

New Leader incandescent units are available in a number of styles, for use with 150 to 500 watt lamps.

Type ISD—Standard Dome—best for general lighting where both horizontal and vertical surfaces are to be lighted, such as workbenches, assembly lines, etc.

Type IDB—Deep Bowl—ideal for machine shops, shipping or receiving departments, assembly lines, print shops.

Type IGS—Glass-Steel Diffuser—for use wherever softer light without sharp reflections is desired. Globe of smooth finish, high grade opal glass.

Type ISA—Symmetrical Angle—to supplement general lighting or for extra illumination on vertical surfaces.

Type IEA—Elliptical Angle—for wide angle horizontal and vertical illumination.

Type IHB—High Bay Unit—for higher mounting heights, such as in warehouse aisles, foundries, etc.



Type ISD—Standard Dome



Type ISA—Symmetrical Angle



Type IDB—Deep Bowl



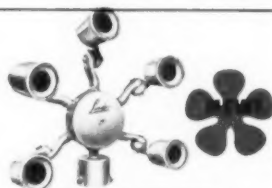
Type IEA—Elliptical Angle



Type IGS—Glass-Steel Diffuser



Type IHB—High Bay Unit



MULTIPLE FLOODLIGHTS
CL-700 ASSEMBLY

For service station and parking lot lighting, outdoor displays, industrial protective floodlighting, home sports area lighting, etc., Leader multiple floodlights are efficient and flexible. 2 to 5 floodlights fit cast aluminum junction box, mounted on pole fitter. Special silicone gasket for long life and dependable all-weather performance. For 300 or 500 watt lamps.

May be used with
STATION MASTER, at right.



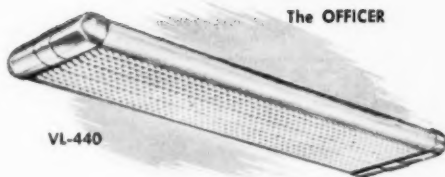
Leader America's No. 1 Lighting Equipment Manufacturer



THG-240

Leader TROFFERLITES furnish an exceptionally fine system of fluorescent lighting, whether used singly or in continuous rows. Available in louvered, open, baffled or glass enclosed styles (or with various types of specialized lenses including Leader's new plastic lens*, flat or curved Holophane Controlens†, etc.) Complete range of lengths, from 24" to 96", in 12" or 24" width, in regular (7 3/8") or shallow (6") depth, for from 1 to 8 lamps.

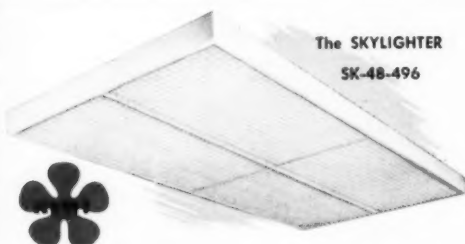
*Pat. Pend. †Copr. The Holophane Co.



VL-440

America's finest fluorescent fixture! Leader's OFFICER provides distinctive lighting for offices, stores, banks, schools, libraries. Steel channel, deep drawn end caps, side panels in choice of steel or translucent plastic. Plastic louver** in choice of 45° or 31° shielding angle. Swings down from left or right for maximum ease of servicing. Available for 2, 3 or 4 lamps, either 40-watt or Slimline in 48", 72" or 96" length. May be mounted singly or in continuous rows, either direct to ceiling or suspended.

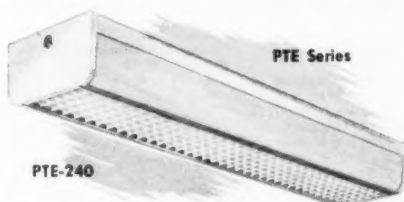
**Made under Pat. No. 2566817



The SKYLIGHTER
SK-48-496

Leader's new SKYLIGHTER is the answer to the demand for more light and better light. These distinctive new surface mounted fixtures provide floods of glareless light. May be used singly, or mounted end to end or side by side, to form a variety of striking illumination patterns, or to provide a complete ceiling of light. 40" x 40" plastic louver** or choice of various types of plastic diffusion inserts. Available in sizes from 2' x 2' to 4' x 8'.

**Made under Pat. No. 2566817



PTE-240

Outstanding for store lighting! Leader's PTE Series has been expressly designed to provide economical and efficient store lighting. Installation of these fixtures enhances the appearance of displays and counters and makes store interiors more inviting and attractive to customers. Side panels in choice of ribbed Albalite glass or translucent plastic; bottom panel in choice of flat Albalite glass, plastic lens*, or plastic louver** with 40° x 40° shielding. For 2, 3 or 4 lamps, either 40-watt or Slimline in 48", 72" or 96" length.

*Pat. Pend. **Made under Pat. No. 2566817



The STATION MASTER

Leader's STATION MASTER, for service station island lighting, delivers high intensity of light without glare. Puts light where it is needed - where the sale is made and service rendered. Rugged weather-proof construction throughout. Available in lengths from 4 ft. to 20 ft., with continuous one-piece channel. Sliding pole fitter adjustable to any pole spacing.

Provision for floodlight mounting 4" from each end and in center of fixture. Use multiple lights, shown at left, or single floodlight.

Sold and installed by the better electrical wholesalers and contractors

Leader

LEADER ELECTRIC COMPANY

3500 North Kedzie Avenue • Chicago 18, Illinois

Leader Electric-Western: 800 One Hundredth Avenue, Oakland 3, California
Campbell-Leader, Ltd.: Brantford, Ontario, Canada

11.1 DATA TABLES (Continued)

ISOLATION BY ELEVATION

Distance of Live Parts Above the Floor or Other Working Surface

Voltage Between Phases	Minimum Vertical Clearance of Unguarded Parts Feet	Inches
600	8	0
2300	8	0
6600	8	0
11000	9	0
22000	9	3
33000	9	6
44000	9	10
66000	10	5
88000	11	0
110000	11	7
132000	12	2

WORKING SPACE

Minimum Clear Space Adjacent to Live Parts

Voltage Between Phases	Minimum Horizontal Clearance of Unguarded Parts Feet	Inches
600	3	2
2300	3	3
6600	3	4
11000	3	6
22000	3	9
33000	4	0
44000	4	4
66000	4	11
88000	5	6
110000	6	1
132000	6	8

MAXIMUM NUMBER OF CONDUCTORS IN BOXES

Deep Boxes

Box Dimensions Trade Size	No. 14	No. 12	No. 10	No. 8
1-1/2 x 3-1/4 octagonal	5	5	4	0
1-1/2 x 4 octagonal	8	7	6	5
1-1/2 x 4 square	11	9	7	5
1-1/2 x 4-11/16 square	16	12	10	8
2-1/8 x 4-11/16 square	20	16	12	10
2 x 1-3/4 x 2-3/4	5	4	4	
2-1/2 x 1-3/4 x 2-3/4	6	6	5	
3 x 1-3/4 x 2-3/4	7	7	6	

Shallow Boxes of Less Than 1 1/2" Depth

Box Dimensions Trade Size	No. 14	No. 12	No. 10
3-1/4	4	4	3
4	6	6	4
4-11/16	8	6	6

Combinations

Size of Conductor	Free Space Within Box For Each Conductor
No. 14	2. cubic inches
No. 12	2.25 cubic inches
No. 10	2.5 cubic inches
No. 8	3. cubic inches

FULL-LOAD CURRENT*

Single-Phase A-C Motors

HP	115V	230V	440V
1/6	3.2	1.6	
1/4	4.6	2.3	
1/2	7.4	3.7	
3/4	10.2	5.1	
1	13.	6.5	
1 1/2	18.4	9.2	
2	24.	12.	
3	34.	17.	
5	56.	28.	
7 1/2	80.	40.	21.
10	100.	50.	26.

FULL-LOAD CURRENT*

Three-Phase A-C Motors

Induction Type Squirrel-Cage and Wound Rotor Amperes

Synchronous Type Unity Power Factor Amperes

HP	115V	230V	550V
1/2	4.6	2.3	.....
3/4	6.6	3.3	1.4
1	8.6	4.3	1.8
1 1/2	12.6	6.3	2.6
2	16.4	8.2	3.4
3	24.	12.	5.0
5	40	20.	8.3
7 1/2	58	29.	12.0
10	76.	38	16.0
15	112	56	23.0
20	148	74	31.
25	184	92	38.
30	220	110	46.
40	292	146	61
50	360	180	75
60	430	215	90
75	536	268	111
100		355	148.

HP	110V	230V	440V	550V	2300V	230V	440V	550V	2300V
1/2	4	2	1	.8	—	—	—	—	—
3/4	5.6	2.8	1.4	1.1	—	—	—	—	—
1	7	3.5	1.8	1.4	—	—	—	—	—
1 1/2	10	5	2.5	2.0	—	—	—	—	—
2	13	6.5	3.3	2.6	—	—	—	—	—
3	—	9	4.5	4	—	—	—	—	—
5	—	15	7.5	6	—	—	—	—	—
7 1/2	—	22	11	9	—	—	—	—	—
10	—	27	14	11	—	—	—	—	—
15	—	40	20	16	—	—	—	—	—
20	—	52	26	21	—	—	—	—	—
25	—	64	32	26	7	54	27	22	5.4
30	—	78	39	31	8.5	65	33	26	6.5
40	—	104	52	41	10.5	86	43	35	8
50	—	125	63	50	13	108	54	44	10
60	—	150	75	60	16	128	64	51	12
75	—	185	93	74	19	161	81	65	15
100	—	246	123	98	25	211	106	85	20
125	—	310	155	124	31	264	132	106	25
150	—	360	180	144	37	—	158	127	30
200	—	480	240	192	49	—	210	168	40

For full-load currents of 208 and 300 volt motors, increase the corresponding 230-volt motor full-load current by 6 and 10 per cent, respectively.

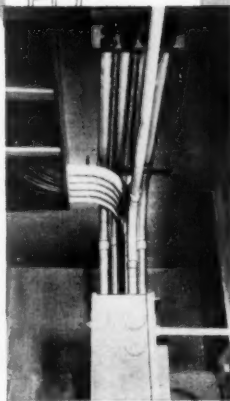
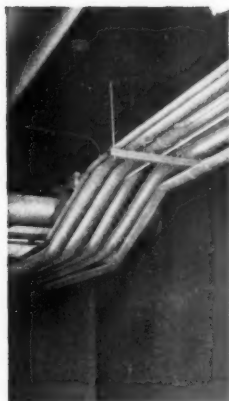
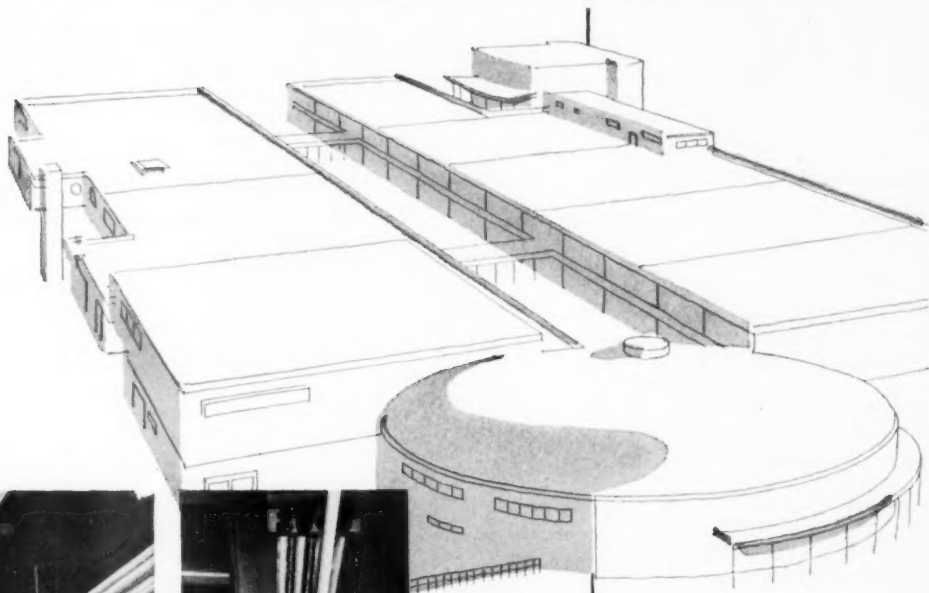
* These values of full-load current are for motors running at speeds usual for belted motors and for motors with normal torque characteristics. Motors built for especially low speeds or high torques may require more running current, in which case the nameplate current rating should be used.

† For 90 and 80 per cent P. F. the above figure should be multiplied by 1.1 and 1.25 respectively.

* These values for full-load current are average for all speeds.

IT'S AMERICA'S

MOST COMPLETE SHOPPING CENTER



and another

SPANG[®]
CENTRAL CONDUIT

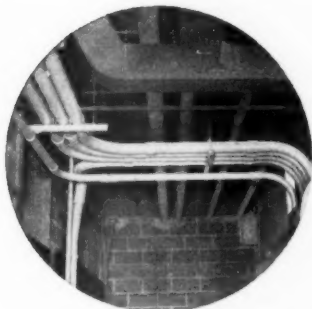
installation

For years architects and merchandisers have been talking about Shoppers' World in Framingham, Mass.—the project that started the whole regional shopping center movement. With 44 stores and parking for 6000 cars, it's the newest, most refreshing note in American merchandising.

Outstandingly modern in architectural design, Shoppers' World is also outstanding for its well planned electrical design. Like so many other projects where the closest attention is given to every electrical detail, Spang Central Conduit was selected to protect all the circuits.

It's one more example of the faith that prominent contractors, architects and owners place in the *truly dependable, quality-controlled* conduit—Spang Conduit.

You, too, will find it pays to use these *better* conduits by Spang—"Central White," "Central Black" and "Central EMT." You'll like the consistent high quality and the faster threading, cutting and bending.



Owner: Jordan Marsh Co., Boston, Mass.
Designed by: George L. Ely
Architects: Ketchum, Gino & Sharp
Consulting Architects: Anderson & Beckwith
Contractor: C. B. H. Macomber Co.



SPANG-CHALFANT

Division of The National Supply Company

GENERAL SALES OFFICE:

PITTSBURGH 30, PA.

District Offices and Sales Representatives
in Principal Cities

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ELECTRICAL CONSTRUCTION & MAINTENANCE • JULY, 1952

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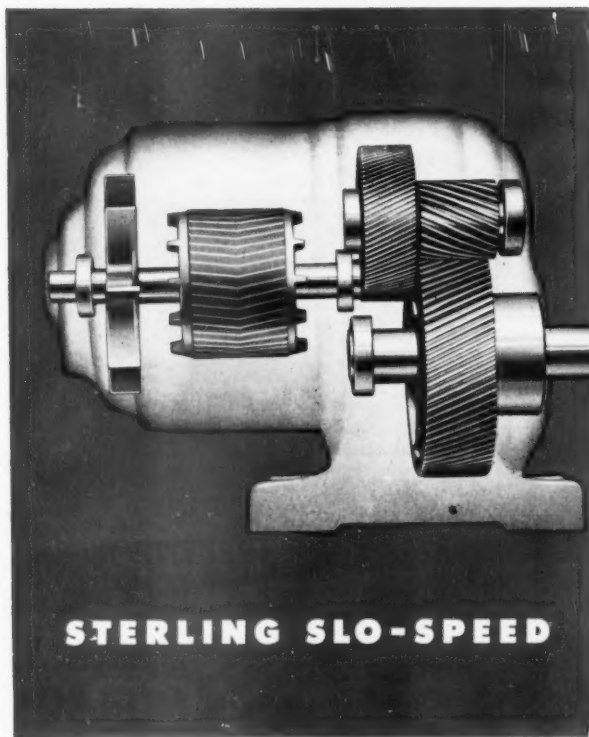
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PUNCH PRESS OPERATION GREATLY IMPROVED WITH



STERLING SLO-SPEED!

Because Slo-Speed geared motors give us the best low speed required for our punch presses, we can use a much larger drive sheave than is possible with a standard motor, thereby gaining much more belt traction with subsequent longer belt life, reports Mr. H. Berry, Assistant Manager of Manufacturing at The Thomas & Betts Company of Elizabeth, New Jersey. We have used Slo-Speeds for years and have yet to replace any worn or broken parts.

STERLING SLO-SPEED GIVES YOU THE ONE BEST LOW SPEED AND

gives uninterrupted service—carries heavy overhung loads—provides versatile mounting and flexibility in arrangement of machinery—saves valuable space—provides greater safety—costs less to install and use. An indispensable source of low speed power for:

Agitators	Dryers	Presses
Blenders	Feeders	Pumps
Blowers	Kilns	Screens
Conveyors	Mills	Tumblers
Cookers	Mixers	Etc., etc.

OTHER STERLING ELECTRIC POWER DRIVES:

- STERLING SPEED-TROL (VARIABLE SPEED) MOTORS
 - STERLING KLOSD AND KLOSD-TITE (NORMAL SPEED) MOTORS
- DRIP-PROOF • SPLASH-PROOF • TOTALLY ENCLOSED**

70 ILLUSTRATIONS showing how Sterling Electric Power Drives reduce production costs. Write for Bulletin No. D-126



OUTSTANDING FEATURES:

Simplified gear system—balanced design — compact — rugged — highly efficient — abundant lubrication—low output shaft—positive oil seals—Herringbone Rotor—protected—streamlined—direct through ventilation—quiet operation—AGMA speeds—extremely long life —every unit will operate in any position.

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Offices and distributors in all principal cities.

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by all **QUALITY** standards...

BENJAMIN *"Magna-Flo"* Systems Excel!

that's why Overall Lighting Costs are **LOWER!**

Because Benjamin "Magna-Flo" Systems excel by every Quality Standard—lighting, electrical and constructional—they can provide high illumination levels at low overall lighting cost. Such cost involves more than the original price of the units. Overall lighting cost also includes the costs of installation, operation,

maintenance and replacement. Add them all up and see why you're ahead with "Magna-Flo" Systems (individual unit or continuous line)—because "Magna-Flo" excels by **ALL QUALITY STANDARDS!**

This chart gives some of the important reasons why:

"MAGNA-FLO" CUTS INSTALLATION COST

wide variety of knockouts facilitate wire entrances into unit.
complete line of sliding hangers.
single, rugged channel coupling for continuous mounting.



"MAGNA-FLO" CUTS MAINTENANCE COST

Porcelain Enamel reflecting surface is easy to keep clean with soap and water.
exclusive "Springlox" lampholders make possible "quick-in, quick-out" lamp maintenance.
Speedy, exclusive "Lok-Latch" reflector fasteners.

"MAGNA-FLO" CUTS OPERATION COST

made for efficient utilization of high light output T12 Slimline lamps.
high power-factor ETL-approved ballasts for continuously-cool, efficient operation.
high reflection factor remains constant because genuine Porcelain Enameled reflector does not discolor or become dull with age.

"MAGNA-FLO" CUTS REPLACEMENT COST

famous Benjamin "built-like-a-battleship" construction of heavy gauge steel.
rigid channels and reflectors withstand toughest industrial vibration.
90° reflectors are made in two sections, kept perfectly aligned by positive alignment clips.

FREE Bulletin AD-5705 brings you complete specifications on Benjamin "Magna-Flo" Lighting Systems—famous for "Task-Matched" Lighting Installations.
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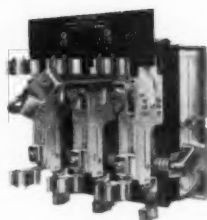
TRUMBULL ELECTRIC

DEPARTMENT OF GENERAL ELECTRIC COMPANY
PLAINVILLE, CONNECTICUT

Quality Distribution and Control Equipment

600 Volts and Below

Enclosed Safety Switches • Enclosed Circuit Breakers • Service Entrance Switches • Trumbullite Load Centers • Motor Control Equipment • Open Knife Switches • Fuse Holders • Lugs and Connectors • Panelboards • Switchboards • Control Centers • Flex-A-Power Bus Bar Distribution Systems.



HCI INTERIOR



TYPE A STYLE HCI
FRONT OPERATED



TYPE A STYLE A



TYPE C



TYPE D

Enclosed SAFETY SWITCHES

Trumbull Enclosed Safety Switches for industrial and service entrance work provide positive disconnecting means and operator safety. A variety of NEMA enclosures are available for most ratings. Available 30 to 1200 amperes as detailed below in 2-, 3-, and 4 pole units. Three lines meet all service requirements.

HEAVY DUTY SWITCHES

TYPE A

Trumbull Type A, Style HCI (High Capacity Interrupter) front operated, is a new heavy duty safety switch that features pole units that are self-contained switches and utilize the magnetic repulsion principle of arc quenching which prevents the pitting of contacts and results in long switch life. Front operation, front fusing and positive ON and OFF action make the HCI today's best switch buy. Supplied in ratings 30 to 100 amperes, 2 and 3 pole, 240 to 600 volts AC, 250 to 600 volts DC. Solid neutral available in 3 and 4 wire. Single throw only, fusible and no fuse. Horsepower rated to 50 hp. **Ask for circular TEC-17.**

Trumbull Type A, Style HCI Interior — This ultra-modern switching device, with the HCI pole unit which utilizes the magnetic repulsion principle, is widely used as a disconnect in combination magnetic motor control, on switchboards, and with control centers. These units are front-operated, rated at 30 thru 100 amperes, 2 and 3 pole, 240 to 600 volts AC, 250 to 600 volts DC. Solid neutral available in 3 and 4 wire. All current-carrying parts are silver-plated and the unique arc-quenching method prevents pitting of contacts. Result: Long, dependable service. Wherever a disconnect is necessary, be sure you have the best, specify HCI. **Ask for circular TEC-17.**

Type A — Trumbull Type A, Style A heavy duty industrial switches are designed to withstand years of rough usage. These switches include such features as: high interrupting capacity; quick-make and quick break to prevent burning and pitting of contact surfaces; all-copper silver-plated contacts; interlocked cover to prevent opening a live switch; and a side operating handle. Supplied in ratings from 30 to 1200 amperes, 240 to 600 volts AC 250 to 600 volts DC, 2 and 3 pole, single and double throw fusible and no-fuse, 4 pole available only in double throw, no fuse switches. Solid neutral available 3 and 4 wire. Horsepower rated to 50 hp. **Ask for Circular TEC-302-A.**

INDUSTRIAL AND ENTRANCE SWITCHES

TYPE C

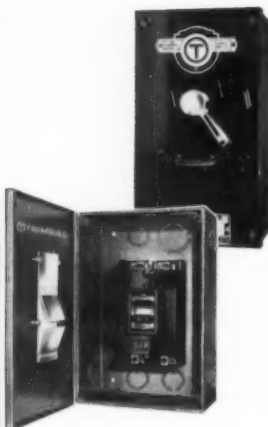
Trumbull, Type C switches are lower in price than Type A and may be used where cover interlock is not required and where operation is infrequent and load conditions are not severe. These switches include quick-make, and quick-break in all capacities. Supplied in 30 to 600 amperes, 2, 3, and 4 pole, 230 to 575 volts AC, 250 volts DC. Horsepower rated to 50 hp. Solid neutral available in all ratings. **Ask for circular TEC-307-A.**

ENTRANCE AND GENERAL PURPOSE SWITCHES

TYPE D

Type D — Trumbull, Type D Side Operated Switches for entrance service and for general purposes. The low cost utility switch for light duty applications. Supplied 30 to 200 amperes, 2 and 3 pole, single throw, fusible and no-fuse, maximum 250 volts. Solid neutral available 2, 3, and 4 wire. **Ask for circular TEC-312.**

Enclosed CIRCUIT BREAKERS — 50, 100, 225 and 600 AMPERE FRAMES



Trumbull General Utility Circuit Breakers — Type AT provide automatic overcurrent and short-circuit protection for general service light and industrial power requirements. They are completely enclosed, non-tamperable units to replace fuses, fused switches and other circuit protection. Available in 2- and 3-pole construction from 15 to 600 amperes inclusive where the distribution of low voltage current (125 to 600 volt AC or 125 to 250 volt DC) is required. In addition, single pole 50 ampere frame size breakers, 125 volt AC or DC are available.

FEATURES . . .

The outstanding features provided by Trumbull Circuit Breakers are:

1. Automatic overload and short circuit protection.
2. Service quickly and easily restored — nothing to renew or replace.
3. Individually sealed and calibrated against tampering.
4. Minimum maintenance.
5. Complete safety (phenolic case provides dead-front construction). Multipole units have common trip . . . all poles open simultaneously.
6. Positive Indication "OFF-ON-TRIPPED" for fast service restoration.

ENCLOSURES

Trumbull General Utility Circuit Breakers are available in General Purpose Sheet Steel — NEMA Type 1; Semi-Dust-tight NEMA

Type 1A and Water and Dust-tight NEMA Types 4 and 5 Enclosures.

MAGNETIC AND MANUAL MOTOR CONTROL EQUIPMENT



TYPE HM MAGNETIC CONTROL



PUSH BUTTON STATIONS



FOR MOTORS UP TO 50 HP.—Trumbull Motor Controls are available in both magnetic and manual types to handle motors up to 50 horsepower. Standard Duty push-buttons in a variety of combinations, can also be supplied.

MAGNETIC MOTOR CONTROL

Trumbull's new magnetic control, Type HM, was designed to provide all of the features that are needed for modern motor control. Type HM is a packaged motor control. That is, certain components, like extra overload relays, auxiliary contacts, extra inter-locks, push-button stations and transformers are packaged separately and may be installed in the field. The overload relays are in themselves a feature. They are very accurately engineered to give precision performance and may be changed from hand reset to automatic reset by a simple adjustment whenever it is desirable to make such a change. Also adjustable in the field are the auxiliary contacts which may be changed from normally open to normally closed after installation. Compactness and modern styling makes another feature by providing the control with an excellent appearance.

STARTERS—Both reversing and non-reversing

starters are available in Sizes 0 through 3. Type HM starters are listed in General Purpose enclosures and Type CM in Watertight and Dust-tight enclosures. All starters provide both overload and under-voltage protection.

CONTACTORS — Used for lighting or heating circuits where overload protection is not essential, contactors are available in the same sizes, ratings and enclosures as starters, and provide undervoltage release.

COMBINATION MAGNETIC STARTERS — This equipment — combining the new HM magnetic starter and disconnect in one enclosure, presents a more attractive appearance than separate devices, saves space, economizes on installation time, provides safety and convenience for the operator. Combinations utilize either HCI fusible or circuit breaker disconnect in General Purpose or Semi-dust-tight enclosures. **Ask for bulletin TEB-8.**

STANDARD DUTY PUSHBUTTONS

Momentary contact, one, two and three button general purpose push-buttons; dust-tight and watertight two button stations; lever

operated explosion-proof two button stations for Class I, Group D and Class II, Groups E, F, and G applications.

BREAKERS LESS ENCLOSURES

The Trumbull line of unit Circuit Breakers include three different types of breakers as detailed below:

TYPE AT—These Trumbull breakers are available either open or enclosed as described under Enclosed Circuit Breakers. Breakers are furnished as standard for front connection. Studs for rear connection can be supplied. Trip units only can be furnished for those ratings equipped with interchangeable trip units.

FRAME SIZES AVAILABLE:

50 amps AT (15-50 amps) — Permanent, non-interchangeable, thermal trip unit.

100 amps ATB (15-100 amps) — Permanent, thermal-magnetic trip unit is non-interchangeable and non-adjustable — compact size.

225 amps AT (70-225 amps) — Interchangeable thermal magnetic trip units. Magnetic trip is adjustable over a wide range of ampere ratings without affecting thermal trip point.

600 amps AT (225-600 amps) — Interchangeable thermal magnetic trip unit. Magnetic trip is adjustable over a wide range of ampere ratings without affecting thermal trip point.

TYPE TQ—These thermal-magnetic breakers are available in ratings from 10 to 50 amperes, single pole, 120 volt AC. For 2-pole operation, two single pole breakers plus a handle extension are used. Each breaker trips independently. These break-

ers are particularly suited for the conditions encountered in the protection of general lighting and appliance branch circuits.

Type TQL—This new plug-in thermal-magnetic circuit breaker has a quick-make, quick-break operating mechanism. Handle is trip free and gives positive indication of operating position OFF, ON, TRIPPED. Available in ratings of 10, 15, 20, 30, 40 and 50 amperes, 120 volts AC single pcle. For 2-pole operation, two single-pole breakers plus a handle extension are used. Each breaker trips independently.

SPECIAL ATTACHMENTS

Trumbull type AT breakers can be supplied with the following special attachments at a list price addition: Shunt Trip; Undervoltage Release; Bell Alarm; Auxiliary Switches (1, 2, 3 and 4 single poles)

CIRCUIT INTERRUPTERS

Circuit Interrupters (non-automatic breakers) are for use as a manual disconnecting device, in place of a non-fusible safety switch 50 to 600 amperes, 2 and 3 poles, 250 volts AC, 125/250 volts DC, 600 volts AC — 250 volts DC.

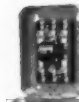
In these units overload or short circuit protection is not provided.

FOR MOTORS UP TO 50 HP.

MANUAL CONTROL



TYPE RB



TYPE MD-5



TYPE TT



TYPE PT

NO OVERLOAD PROTECTION—Type RB is of tumbler switch design and is ideal for use on small motors up to 2 horsepower (250 volt-600 volt AC). It may also be used on heavy duty lighting circuits and Type C lamp loads.

NO OVERLOAD PROTECTION—Reversing — Type MD-5 is used principally for transferring from one source of supply to another, from one motor to another on the same supply, or as a motor reversing controller. It may also be used in combination with Trumbull Type PT Manual or HM Magnetic Starters. 20 amperes, 250 and 600 volts AC, 1½ to 7½ hp. Available in NEMA types 1, 4, and 5 enclosures.

OVERLOAD PROTECTION—Type TT for small motors up to 1 hp. Switch will withstand heavy starting loads or briefs overloads, but will trip before a dangerous temperature is reached. Handle is "trip-free", cannot be held closed against an overload. Wheel-type movable contact of solid silver rolls against stationary silver inlay contacts, minimizing oxidation. Metal handle guard welded to switch cover prevents accidental operation and permits locking. Unit can be furnished without enclosure for built-in applications. Flush mounted starter also available. Single or double pole NEMA enclosures 1, 4, 5, 7, and 9. Ask for circular TEC-317-A.

OVERLOAD PROTECTION—Type PT for AC motors up to 7½ hp. Can be furnished with either toggle or push button type operating handle to suit the requirements of the installation. These starters provide positive, dependable thermostatic overload protection, operator safety and long service life. Starter is "trip-free", cannot be held closed against an overload. Complete starter available in NEMA types 1, 4, 5, 7, 9, and 9A enclosures. Interior only also available for built-in applications.

The 2 hp. size has been especially adapted to the motor control needs of the textile industry. A pedestal is available for use with this loom switch unit. Ask for circular TEC-7.

CENTR-A-POWER CONTROL CENTERS



Trumbull Centr-A-Power is a low cost, pre-engineered method for centralizing motor branch circuit and miscellaneous controls. Modern in appearance, safe and efficient in operation, Centr-A-Power is easy to install and maintain for all types and sizes of industrial and commercial applications. Centr-A-Power utilizes standardized unit sections and compact control units, called Centr-A-Plugs. Ask for circular TEC-8.

FLEX-A-POWER® ELECTRICAL DISTRIBUTION SYSTEMS

Current Ratings from 600 to 4000 Amperes • 2, 3 or 4 Pole

With Copper or Aluminum Bus Bars



Trumbull LVD (Low Voltage Drop) Flex-A-Power is a feeder type busway system for carrying large currents with minimum losses. From transformers to switchboards to distribution circuits, as electrical risers in tall buildings, LVD provides maximum performance at minimum operating and maintenance expense.

Available with copper or aluminum bus bars in ratings from 600 to 4000 amperes in 2-, 3-, or 4-pole construction, 600 volts or less.

FEATURES . . .

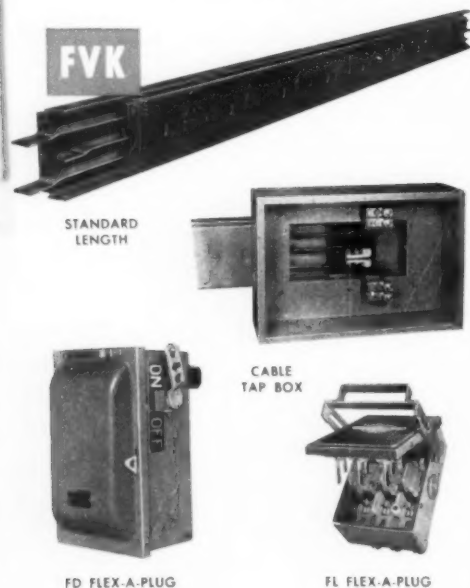
- **Low Voltage Drop** because of close bus bar spacings and interlaced multi-bar construction which keep reactance to a minimum and provide high short circuit resistance.
- **Lower Installation Cost** because Flex-A-Power is shipped completely prefabricated, ready to install. Flexibility permits changing the distribution system to meet changing production requirements.
- **Lower Maintenance Cost** through strong materials, adequately braced and supported internally. Relocation is easy and permits almost 100% reuse of materials.

FITTINGS AND ACCESSORIES

LVD Flex-A-Power is available in 10 foot or shorter straight lengths complete with hangers and joint hardware. Elbows, tees, crosses, tap boxes and many other fittings to meet every application are available. Ask for bulletin TEB-1 or circular TEC-152.

Current Ratings from 225 to 1000 Amperes • 2 and 3 Pole • 3 Phase, 4 Wire

With Copper or Aluminum Bus Bars



Trumbull FVK Plug-in Flex-A-Power generally feeds power to a number of individual loads at various points along the run. Thus, it is often considered to be a panelboard running the length of the plant.

Available in current ratings from 225 to 1000 amperes, the two- and three-pole designs are suitable for 600 volt service. The three phase, four wire design is listed for 120/208 volt service, but can be obtained for 277/480 volt service in ratings from 225 to 600 amperes. Convenient power outlets are provided on 12" centers along the housing. Power takeoffs are made by means of Flex-A-Plugs which contain fusible switches or enclosed circuit breakers.

FEATURES . . .

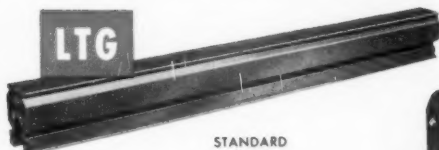
- **Standardised Construction**, easy to install, dismantle and re-install — minimum installation costs.
- **Indestructible Materials** — steel, copper and porcelain for long life and minimum maintenance.
- **Convenient Outlets** closely spaced (every 12" on one side, every 24" on the other) for maximum flexibility in original installation or rearrangement.
- **Horizontal or Vertical Mounting**, unique "ice-tong" hangers eliminate prelocation.

FITTINGS AND ACCESSORIES

Standard FVK Flex-A-Power is furnished in 10 foot lengths, other standard lengths, 2, 3, 4, and 5 feet also available. Necessary hangers and hardware included with each section. Double break fusible switch plug, Type FL, and Motor Circuit Switch Plug, Type FD Flex-A-Plugs as well as circuit breaker Flex-A-Plugs are available. Cable Tap Boxes, End Boxes and Elbows also supplied. Ask for bulletin TEB-4 or circular TEC-151.

Feeder-Plug-in-Trolley Busways for Low Voltage Service

Current Rating 50 Amperes • 2, 3 or 4 Pole • 300 Volts



STANDARD
LENGTH



TROLLEY
COLLECTOR



UNFUSED
PLUG

Trumbull LTG Flex-A-Power is generally used to supply lighting, combined power and lighting, or small power loads when employed as a plug-in busway. As a trolley busway it is used to feed portable tools, cutting machines, small cranes, etc.

A complete line of plugs and trolleys of the circuit breaker, fusible or no fuse types provides maximum flexibility. Standardized fittings for the busway including 10 foot and shorter lengths, elbows and tap boxes meet every installation need. Lengths and fittings are quickly joined with bus connectors and coupling plates.

FEATURES:

- A rugged standardized 50 ampere, 2-, 3-, or 4-pole busway, easily and economically installed with almost 100% reuse if the system is relocated.
- A continuous outlet from end to end for plugs or trolleys, power where you want it.
- 300 volt rating makes it usable on 277/480 volt distribution systems for economy and flexibility.
- Plugs and trolleys for every application need. Ask for bulletin **TEB-2** or circular **TEC-3**.

Current Rating 100, 200 and 400 Amperes • 2 or 3 Pole • 600 Volts



STANDARD
LENGTH



TROLLEY
COLLECTOR



200 AMP.
TROLLEY COLLECTOR

Trumbull TK Flex-A-Power heavy duty trolley busway is generally used for large cranes or portable tools, although it can be used where a mobile power take-off is required.

For safety and flexibility TK Flex-A-Power provides power where you want it without hazardous trailing cables. Standard 10 foot or shorter lengths in all sizes with end and feed-in boxes for various applications.

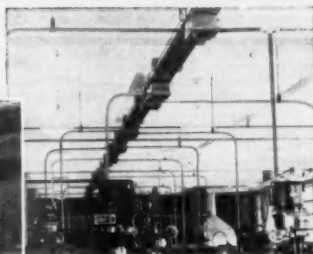
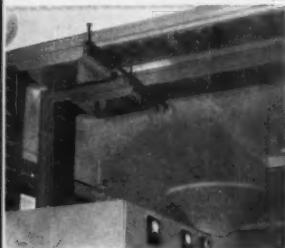
Trolleys for many applications available in a wide range of types.

FEATURES:

- 100 ampere system available with radius sections to follow monorail installations. Slide-out sections for easy trolley insertion and removal at selected points.
- 200 and 400 ampere systems have aluminum housing for indoor and outdoor installation. Trolleys are inserted and removed at joints between sections.



LVD FLEX-A-POWER
INSTALLATION FOR POWER
DISTRIBUTION



FVK FLEX-A-POWER
PROVIDES POWER FOR
INDIVIDUAL MACHINES

TK FLEX-A-POWER
FOR PORTABLE POWER



LTG FEEDS LIGHTING
IN A MODERN FACTORY

SERVICE ENTRANCE EQUIPMENT



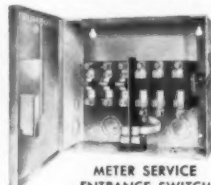
FUSE PULLER



ENTRANCE AND
TRANSFORMER SWITCH



RESIDENCE PANEL



METER SERVICE
ENTRANCE SWITCH

Trumbull service entrance equipment, approved by Underwriters' Laboratories, Inc. is widely used in homes, apartments, farm buildings, garages, etc.

In addition to providing protection for the mains, this equipment, in most cases, also provides overload protection for the branch circuits.

FUSE PULLER — The residential panel for main, range and lighting circuit protection, with terminals for water heater connection . . . provided with snap action, self-wiping contacts that cannot "ride-out" or "loosen-up" from vibration. Available in flush or surface type for indoor installation and in weather-proof enclosure for mounting outdoors. **Ask for circular TEC-311A.**

ENTRANCE AND TRANSFORMER SWITCH — A main disconnect switch of the RBA style with space and terminals provided for mounting control transformers within the cabinet. The top end of the cabinet is equipped with standard meter knockouts and back plate for mounting various sizes of polyphase meters.

RESIDENCE PANELBOARDS — Attractively designed for installation in convenient locations in the home, this unit saves time and steps in replacing fuses. The Trumbull design, with removable interior and abundant knockouts, permits faster installation and easier wiring.

METER SERVICE ENTRANCE SWITCH — A main disconnect switch, operated externally, with accessible fuses. Top ends of cabinet equipped with twistouts for simple installation of standard meters. Facilities are provided for testing meters, wiring sequence, switch-meter-fuse.

LIGHTING and POWER DISTRIBUTION PANELBOARDS

NLTQ
PANELBOARD



Trumbull manufactures a complete line of panelboards to suit the requirements of any installation. Circuit breaker panels and those offering switch and fuse protection are available for both lighting and power distribution. Column type panels are available for installation in H columns.

The information shown here illustrates the scope of the Trumbull line:

LIGHTING PANELBOARDS

NLTQ Circuit Breaker Panelboards (AC only). This great new panelboard is a Trumbull development which includes the first real innovations to be made in panelboards in many years. A good example is the interior which is made of plastisol, a plastic material which is non-aging, non-shrinking and non-tracking. The busbars are completely enclosed in this material where they run 10% cooler than in air and have firm support to keep them from being distorted by severe overloads. The branch circuits are protected by another completely new product, the TQL circuit breaker. The compact TQL is the first plug-in breaker that is quick-make, quick-break, with thermal-magnetic trip.

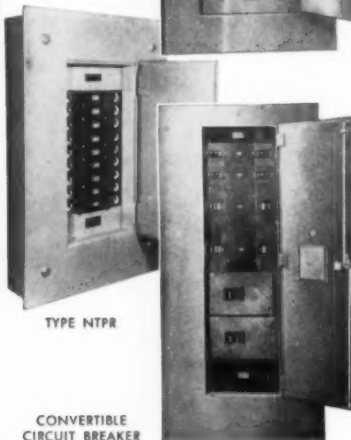
NLTQ Panels have from 4 to 42 circuits. Mains are 3 wire, 120/240 volt, or 4 wire 3 phase, 120/208 volts. Branches are 2 wire, 120 volt. Mains are equipped with either lugs or Type AT circuit breakers. **Ask for bulletin TEB-14.**

NLAB Circuit Breaker Panels (AC only). These panelboards, which use the Trumbull TQ breaker for branch circuit protection, can be supplied from 4 to 42 circuits. Mains may be equipped with lugs or with Type AT circuit breakers. The TQ breaker used in the branches is quick-make, quick-break with thermal-magnetic trip and is trip free. NLAB Panelboards are available with either 3 wire or 4 wire, 3 phase mains and 2 wire 120 volt AC branches.

NAB Circuit Breaker Panels (AC and DC). These Trumbull Circuit Breaker panelboards have from 4 to 42 branch circuits which are protected by Type AT circuit breakers. These breakers are single pole, with thermal trip and may be rated from 15 to 50 amperes. The AT breaker is also quick-make and quick-break and trip-free. Mains may be equipped with either lugs or circuit breakers and may be either 3 wire or 4 wire, 3 phase. Branches are 2 wire, 120 volts. **Ask for circular TEC-321.**

TYPE NTFR

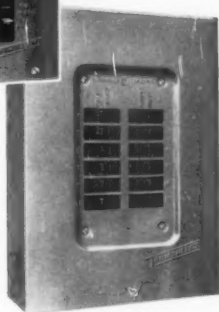
CONVERTIBLE
CIRCUIT BREAKER



TRUMBULLITE LOAD CENTERS



4 CIRCUIT
TRUMBULLITE



12 CIRCUIT
TRUMBULLITE

Trumbull now provides the new TQL circuit breaker, a quick-make, quick-break thermal-magnetic device, in a new line of residential load centers called Trumbullite. This type of breaker is basically the same as that used in high priced panelboards for industrial application. Available in a complete range from 1 to 20 circuits, 40 through 100 ampere mains in flush, surface and raintight enclosures.

FEATURES . . .

- **Plug-in, quick-make, quick-break circuit breakers.**
- **Sequence phasing** (12 through 20 circuits).
- **Thermal-magnetic protection.**
- **Trip-free**, handle cannot be held closed against a serious overload or short circuit.
- **Panelboard construction** at load center prices (12 through 20 circuits).
- **Removable interiors** for ease in wiring.

Ask for bulletin TEB-12.

2 through 8 Circuits

2, 4, and 8 circuit bus bars and stabs are silver-plated copper. Pressure contacts on the plug-in TQL breaker

engage the stab assembly firmly and securely. The interiors are mounted on pins and are easily removable to simplify wiring.

12 and 20 Circuits

The 12- and 20-circuit interior is of panelboard construction. Interiors are reversible end-for-end, with top or bottom feed optional, and are designed for sequence phasing. Bus bars and stab assembly are encased in Plastisol—a polyvinyl-chloride plastic material offering many advantages: highly resistant to alkali or acid; non-shrinking and non-tracking. Actual tests show that bus bars encased in this material run 10% cooler than in open air.

NTP or NTC switch and fuse panels (AC or DC). These Trumbull panels, from 4 to 40 circuits, 60 to 200 ampere mains, are supplied with individually enclosed tumbler switches and provisions for 30 ampere plug or cartridge fuses in the branches. Mains may be equipped with lugs or safety fuse Swing-wa units, and are for either 3 wire or 4 wire 3 phase service. Branches are 2 wire, 120 volt, AC, solid neutral. Ask for circular TEC-326.

NTPR Switch and fuse panels (AC or DC). These low-cost lighting panelboards incorporate the unique Trumbull six circuit section, which provides from 6 to 42 circuits. The branches are equipped with tumbler switches and plug fuse receptacles. Mains are 60 to 200 amperes, with main lugs only, for 3 wire or 4 wire, 3 phase service. Branches are 2 wire, 120 volts. Ask for circular TEC-4.

DISTRIBUTION PANELBOARDS

ABH Circuit Breaker Panelboards—Breakers are assembled on a heavy steel back plate, drilled for universal mounting of 50 ampere frame size breakers, one, two or three pole. This permits ready interchange of circuit breakers, which may be necessary to accommodate changes within an electrical wiring system. Maximum 400 amp lugs or 225 amp circuit breakers. 15-50 amp one, two or three pole AT branch circuit breakers.

Convertible Circuit Breaker Panelboards (AC or DC)—These Trumbull distribution panels are of the unit sectional type and thus offer the maximum degree of convertibility. Space for future circuits can be provided. Because of the standardization of breaker dimensions, it is possible to interchange breaker unit of different poles or capacities. These convertible panels can be furnished for single phase or DC, 2- or 3-wire; three phase, 3- or 4-wire; maximum 250 volts DC, 600 volts AC. Mains can be supplied with 1200 ampere lugs or 600 ampere circuit breakers, maximum.

Branches: 15 to 600 amperes—1, 2, or 3-pole circuit breakers. Either surface or flush types can be supplied. Ask for circular TEC-303.

SWING-WA® PANELS (AC or DC)—This form of Trumbull construction provides a deadfront, safety-type panelboard. Each Swing-Wa unit is individually enclosed in its own protective steel compartment. The door supports the switching contacts and when opened entirely disconnects the circuit and provides access to the fuses. Available for single phase or DC, 2- or 3-wire; maximum 250 volt DC, 575 volt AC. Mains: 1200 ampere lugs or 600 ampere switch maximum. Branches: 30 to 600 ampere, 2 or 3 pole. Ask for circular TEC-305.



CONVERTI-FUSE® PANELS (AC or DC)—This Trumbull panelboard, of the dead-front type employs Converti-Fuse Caps which contain the fuses. These caps are inserted into molded phenolic sections. When the cap is pulled it acts as a switch . . . fuses can be changed safely away from the panel. It is not necessary to remove the fuses to disconnect any circuit (merely remove cap, turn 180° and replace). Spare parts are available so that branch circuits can be converted to a higher or lower capacity. Available single phase or DC—2- or 3-wire; three phase, three or four wire; maximum 250 volt DC, 575 volt AC. Mains: 1200 ampere lugs or 400 ampere switch maximum. Branches—30 to 400 ampere, 1, 2, or 3 pole. Ask for circular TEC-306.

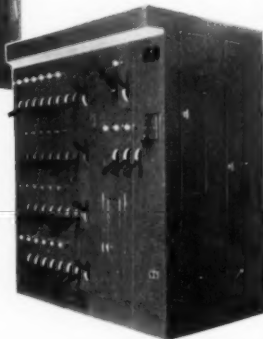
TRUMBULL  ELECTRIC

SWITCHBOARDS DEAD FRONT — MAXIMUM 600 VOLTS AC



CENTR-A-POWER
SWITCHBOARD

CONTROLITE
THEATER
SWITCHBOARD



Trumbull factory prefabricated switchboards offer maximum ease of installation, safety and low maintenance. All units are of dead front construction for operator safety and attractive appearance.

CENTR-A-POWER SWITCHBOARDS

Centr-A-Power Switchboards are safe, economical assemblies of a wide range of fusible switches and circuit breakers called Centr-A-Plugs, mounted in vertical sections. For main or distribution circuits, 600 volts or less, Centr-A-Plugs are available as fusible switches, 30 to 600 amperes, circuit breakers 15 to 1600 amperes. Centr-A-Power is built up of completely enclosed, self-supporting steel sections of standard 90" switchboard height, in which main and branch busing is isolated from line and load wiring by steel barriers. Centr-A-Power is designed to line up with standard rigid type switchboards. Ask for bulletin TEB-3.

FOI SWITCHBOARDS

These Trumbull switchboards are assemblies of formed steel panels incorporating Trumbull Type FOI (front operated-interlocking) units in any number as required by the installation. Each panel, together with its steel framework, is an individual section and such sections in any number, may be bolted together to form a complete switchboard. The FOI units are fusible switches of heavy duty Type A construction and are rated from 30 to 1200 amperes, up to 600 volts AC or 250 volts DC and in 2, 3, or 4 pole construction. Ask for circular TEC-304.

CIRCUIT BREAKER SWITCHBOARDS

Trumbull circuit breaker switchboards consist of a unit frame which incorporates formed steel panel sections in which are mounted Type AT circuit breakers. Switchboards offer extreme flexibility and are easily expanded to take care of future requirements. Available in ratings from 15 to 600 amperes; up to 600 volt AC or 250 volt DC, and can be supplied with 1, 2, and 3 pole construction. Ask for circular TEC-318.

OTHER TRUMBULL PRODUCTS

OPEN KNIFE SWITCHES — Available from 30 to 5000 amperes, 250 and 600 volts. Single and double throw and front connected and back connected. Types A and C. Telephone and battery switches. rated at 30 amperes only, 125 volts also supplied.

FUSE HOLDERS AND CLIPS — Trumbull Vystipe® clamps and standard clips, ferrule and knife blade fuses with slate base, 1, 2, 3 and 4 pole, 250 and 600 volts and fuse holders 30 to 1200 ampere capacity available.

LUGS AND CONNECTORS — Trumbull manufactures a complete line of solderless lugs and connectors, 30 to 1200 ampere for standard wire sizes. Ask for circular TEC-332.

CONTROLITE®

Is a combined switchboard and dimmer bank that is used wherever control of lighting is desired — in such places as theatres, auditoriums, arenas, night clubs, etc. Because of Controlite's complete internal wiring, installation is merely a matter of making connections to main lugs and branch circuit terminals. Main and branch circuits are protected by built-in overcurrent protective devices.

TRUMBULL  ELECTRIC

DEPARTMENT OF GENERAL ELECTRIC COMPANY

PLAINVILLE, CONNECTICUT

EXECUTIVE OFFICES AND FACTORIES PLAINVILLE, CONN., U. S. A.

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Represented in Canada by Canadian General Electric Co., Ltd.

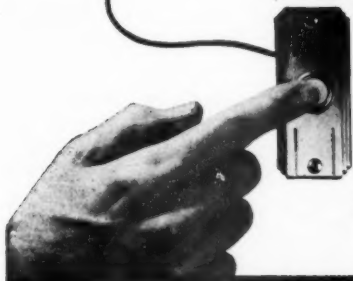
Foreign Representation through International General Electric Co., Inc.

Complete

SIGNALING SYSTEMS

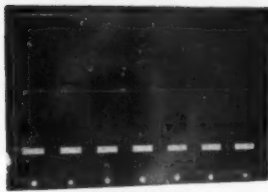


FROM *One* RESPONSIBLE SOURCE



Whether it's a hospital or a school, a housing project or an industrial plant, Auth makes the signaling systems for it — complete! Protect your reputation by specifying reputable systems . . . Eliminate confusion . . . simplify your work . . . and save money for your client.

On your next commission place the responsibility for all signaling and communication equipment with Auth, a Company having more than half a century of experience in this field. You'll be glad you did.



FOR HOUSING

U.S. Approved Mail Boxes; Doorbell Systems and Mechanical Door Chimes; Telephone and Fire Alarm Systems.



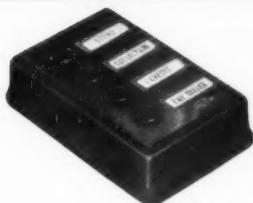
FOR HOSPITALS

Nurses' Call, Doctors' Paging, and "In and Out" Register Systems; Clock, Telephone, Fire Alarm Systems; Night Lights.



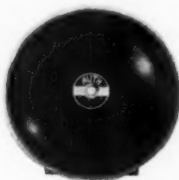
FOR SCHOOLS

Clock, Program Bell, and Fire Alarm Systems; Telephone and Miscellaneous Signaling Systems.



FOR OFFICES

Buzzer, Annunciator, and Clock Systems; Telephone, Fire Alarm, and Elevator Signaling Systems.



FOR INDUSTRIAL PLANTS

Fire Alarm, Telephone, and Paging Systems; Clock and Program Bell Systems; Supervisory Annunciators.



FOR COMMERCIAL HOUSES

Telephone, Clock, and Fire Alarm Systems; Buzzer, Annunciator, and Paging Systems.

MANUFACTURERS OF
Electrical Signaling,
Communication and
Protective Equipment for
Housing, Hospitals,
Schools, Offices, Ships,
and Industry.



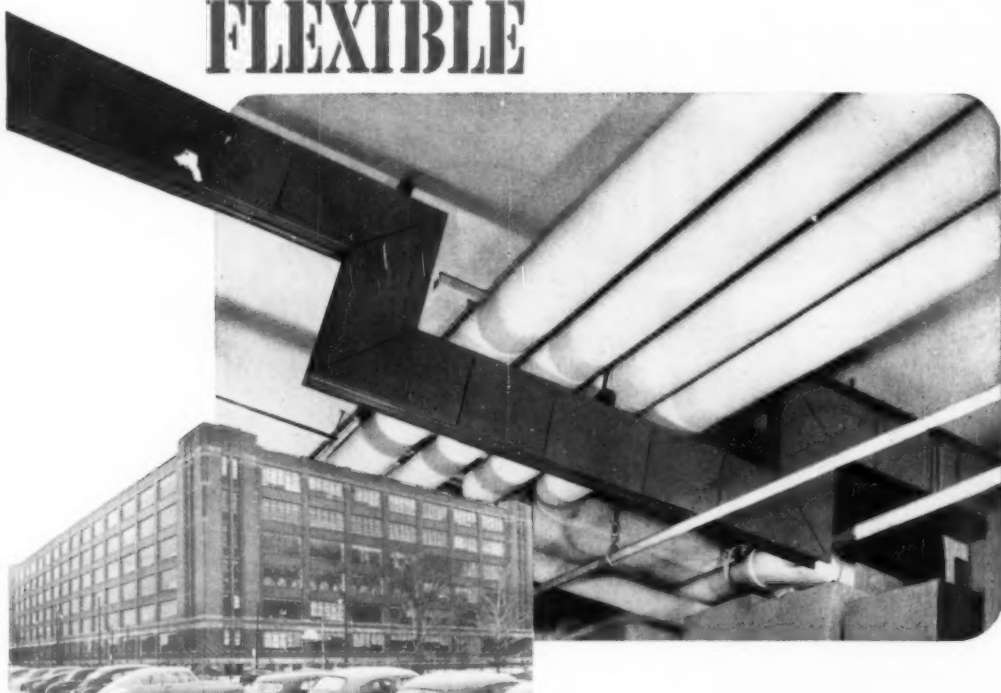
*Descriptive Literature upon Request
Sales Representatives in Principal Cities*

COMPLETE SYSTEMS • ONE RESPONSIBILITY

AUTH ELECTRIC COMPANY, INC.

34-20 45th St., Long Island City 1, N.Y.

BUS DUCT IS FLEXIBLE



Parke, Davis & Company plant modernizes with Westinghouse Bus Duct

"Neat . . . clean . . . flexible!", say Parke, Davis & Company engineers about the installation. The contractor reports, "My men liked installing Westinghouse Bus Duct . . . and the ease of mounting it around pipes, through walls and across wide open spaces saved us considerable time and money."

This vast installation of standardized Low Impedance and Plug-In Bus Duct has recently been completed at the Parke, Davis & Company, Detroit, Michigan, where a complete changeover was made from a d-c to an a-c system.

This duct has greater current-carrying capacity pound for pound than any other means of secondary

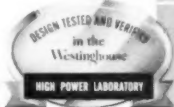
power distribution. Plug-In Duct has outlets every foot to allow for rapid machine tie-ins. Duct sections are fully salvageable and can be expanded or relocated with little effort.

Four types of Westinghouse Bus Duct are available to meet any load condition and service requirement. Call your Westinghouse Representative for complete details or write for B-4272-A. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

J-30107

YOU CAN BE SURE... IF IT'S
Westinghouse

BUS DUCT





MORE KVA PER POUND!

Lightweight, dry-type transformers save space, cut installation costs. 3 through 167 kva, single phase, or 9 through 225 kva, three phase.

They're lighter and smaller! Compact, completely ventilated coils on Hipersil® cores—neatly enclosed in sheet steel cases for convenience of mounting, cleanliness, trim appearance.

Add all this to the savings inherent in dry-type transformer design:

NO VAULTS. Mount them on the floor, walls, posts or overhead platforms, close to the load they serve. They're safe.

SIMPLIFIED MAINTENANCE. No liquids to store, filter or replace. No gauges, radiators, valves or gaskets to get out of order.

Westinghouse Dry-Type Transformers are available for voltage step-down or step-up applications or for phase changing. Types AJRB and AVR8 (3 through 100 kva) have circuit breakers built into the high-voltage circuit, giving 3-way protection against damaging overloads or short circuits, cutting installation time up to 50%. Ask your Westinghouse representative for a copy of B-4428, or write Westinghouse Electric Corporation, P. O. Box No. 868, Pittsburgh 30, Pennsylvania.

J-70607



YOU CAN BE SURE... IF IT'S
Westinghouse



**DRY-TYPE
TRANSFORMERS**



WHAT *Life-Lines* REALLY DELIVER IS MORE SERVICE...LESS SERVICING

How to spot a truly pre-lubricated motor

You are looking at the first motor made to utilize pre-lubrication to its *utmost*. Notice the bearing hub. It was *designed* for a pre-lubricated bearing. There are *no* grease fittings or plugs. The way to grease this modern motor is *don't*.

Westinghouse—the pioneer in pre-lubricated motors—announced in 1948, after 15 years of tests in the laboratory and on the job throughout industry, that Life-Line motors needed no further lubrication. That meant what it said; still means it. You don't have to lubricate them in six months or six years. You don't have to lubricate them—period!

This means you can't grease a Life-Line motor incorrectly. No chance to push dirt into bearings . . . to force grease through seals and into

windings. No chance for greasing errors at all! Lubrication problems are out.

So be sure you get a truly pre-lubricated motor. Look for one that has no grease fittings. You'll know then it means what it says and needs no greasing attention. You'll find your answer in Life-Lines. Remember this is but one reason why Life-Lines offer you more service on the job . . . less servicing.

Ask your Westinghouse representative about other reasons—all steel construction and greater electrical strength. And ask for a free copy of "Facts on Pre-Lubricated Bearings" (B-4378), or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21705



YOU CAN BE SURE... IF IT'S
Westinghouse

Life-Line

MOTORS and CONTROLS

Reduce Downtime after circuit faults

USE AB-I CIRCUIT BREAKERS

Figure it this way. When a Westinghouse AB-I Circuit Breaker trips . . . anyone can "Reset" it in seconds after the fault is cleared. Simply turn the handle to "Reset" and back to "On". Production down time is minimized.

Compare this with outages on other types of circuit-protective devices. Men and machines stand idle, waiting for an element replacement. You lose valuable production time.

Think it over. You consume expensive time replacing elements. Multiply your total outages by this down time. Can you afford the waste?

AB-I Breakers require no replacement parts, eliminate the repetitive use of critical materials.

Other exclusive AB-I features include unequaled "De-ion"[®] Arc Quenching, quick-make, quick-break mechanism, low wattage loss and ability to carry temporary nondangerous peak overloads without tripping.

Find out why AB-I Circuit Breakers pay. Call your Westinghouse Distributor or write for B-5456, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-30092



YOU CAN BE SURE...IF IT'S
Westinghouse

AB-I Circuit Breakers
THE COMPLETE LINE



"Of course, circuit breakers save money."

The Only Ballast of its kind



NEW LEAD-LAG SLIMLINE BALLAST

- Small as a series ballast
- Economical as a series ballast

Compare size, weight, price and power loss to a series ballast—then *add* longer lamp life, better maintenance, positive stroboscopic correction. That's the new Westinghouse LEAD-LAG ballast now available for all slimline lamps. No more lamp replacement guesswork . . . full-rated lamp life . . . more satisfied slimline customers. Get the whole story. Send for B-5614, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-04315

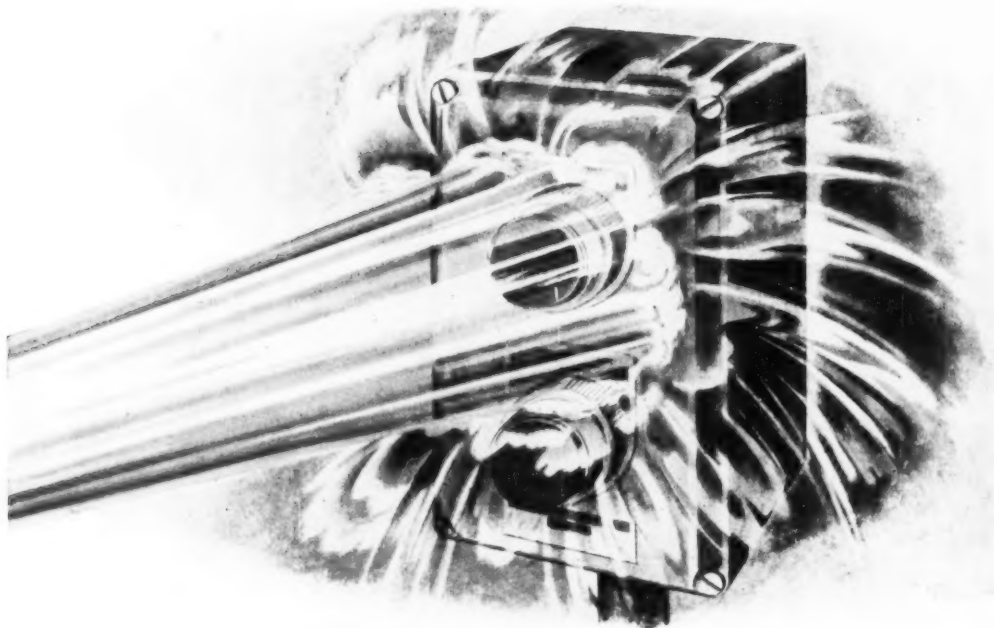


YOU CAN BE SURE...IF IT'S
Westinghouse

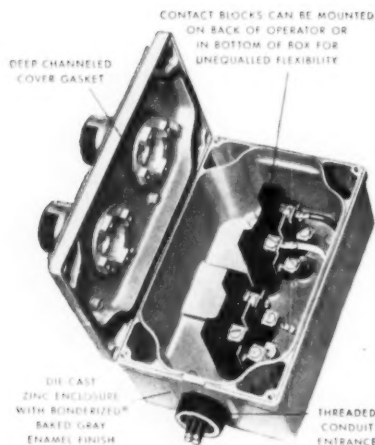
LIGHTING DIVISION

Edgewater Park, Cleveland, Ohio





User's test proves Westinghouse pushbuttons stop "AquaJet*" Water Stream 300 psi at 3 feet



"We have subjected Westinghouse Pushbutton Controls to multiple tests in our own plant—found them highly satisfactory, and are installing them in our new Atlanta plant," says Kraft Foods Company.

"Tests consisted of directing a stream containing chlorides and detergents from an 'aquaJet' cleaning device, 300 psi**, 175° F., at a distance of three feet—onto the face of the pushbutton units—at the gasket seal, mounting holes and other points, for a minimum of 10 seconds at each location. Westinghouse Controls have conclusively proved themselves moisture tight."

In thousands of installations, Westinghouse Oil-Tite® Controls provide unflagging protection against oil, coolant, cutting compounds and water. Maximum unit flexibility for virtually any desired mounting or station combinations.

Contact your Westinghouse representative or write for Booklet DB 15-022, Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pa.

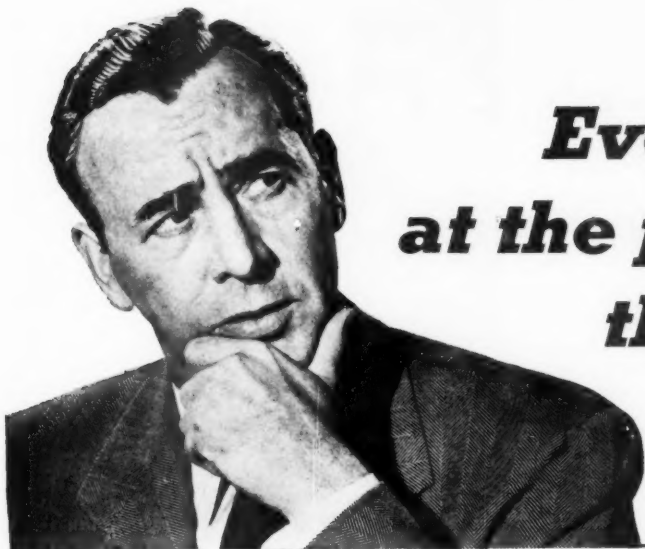
J-30070

YOU CAN BE SURE...IF IT'S
Westinghouse

**OIL-TITE
CONTROL STATIONS**



* (C) Lion Mfg. Co.
** Pounds per square inch



Ever look at the problem this way?

Contractors and engineers have to be walking encyclopedias of electrical knowledge to plan intelligently and to buy wisely. First, because constant improvements and changes are being made in all kinds of apparatus and supplies. Second, because new and more complex installations are being called for. Third, because there are literally thousands of items that you must be familiar with to provide the most efficient and economical specifications.

That's where your Wesco salesman can be of real help to you. He doesn't presume to know your business. But, he's a specialist you can add to your staff. His job is knowing about all types of electrical equipment . . . and particularly about the latest developments. He's a valuable source of information. He has at his fingertips more than 18,000 items handled by Wesco.

More than being just a supplier, Wesco has been built on service. Where you have a special problem to meet, your Wesco salesman can bring the resources of trained personnel and long experience to bear upon it.

When you face a new problem . . . when you need service fast . . . when you want to explore ways of doing a job better . . . come to Wesco first. There are 111 Wesco offices, one of which is conveniently near you.



Westinghouse Electric Supply Co.

A National Distributing Organization

40 WALL STREET, NEW YORK 5, N. Y.

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . JULY, 1952

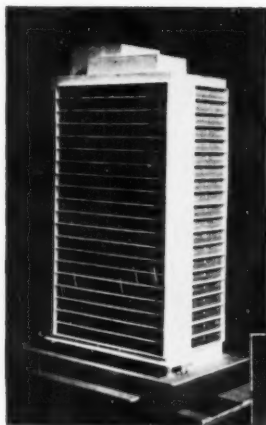
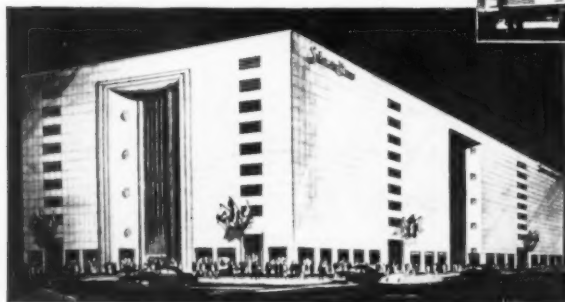
181

How Houston gears for electrical growth with G-E Q-FLOOR WIRING

As the skyline of Houston, Texas, grows, the requirements for expanded electric service *within individual buildings* grow. These four buildings, with G-E Q-Floor wiring, are prepared for the future—whenever the rearrangement of office or store equipment demands additional electrical service.

The steel cells of Q-Floors provide the ultimate capacity for the wires of power, signal, and telephone circuits. Outlets can be installed at any time to provide electrical facilities where needed over the entire floor area. And the provision for electrical expansion will outlast the building itself.

To provide for tomorrow's changing needs of electrical growth, specify G-E Q-Floor wiring. Write for the complete story—a copy of the *G-E Q-Floor Wiring Data Manual*. Section C4-718, Construction Materials Division, Bridgeport 2, Connecticut.



←Melrose Building

Architect: Lloyd & Morgan
Gen. Contr.: Tellepsen Constr. Co.
Consulting Engr.: Herman Blum
Elec. Contr.: Mirsh Elec. Co.
Owner: Melvin A. Silverman and
Bennett Rose

This new Q-Floor building will always be ready for unforeseen changes in floor arrangements . . . changes that demand new electric outlets.

Bank of Commerce Building→

Architect: Alfred C. Finn, F.A.I.A.
Gen. Contr.: Manhattan Constr. Co. of
Texas
Elec. Engr.: Reg. F. Taylor
Elec. Contr.: The Howard P. Foley Co.
Owner: The National Bank of Commerce of Houston

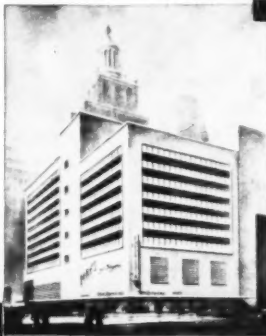
With G-E Q-Floor wiring, electric outlets can be added or relocated quickly — without disturbing this building's tenants.



San Jacinto Building

Architect: Kenneth Franksheim, F.A.I.A.
Gen. Contr.: W. S. Bellows Const.
Corp.
Struct. Engr.: Ward Butterwick
Elec. Engr.: Reg. F. Taylor
Elec. Contr.: J. S. Copeland Elec. Co.
Owner: Brown-Bellows-Smith, Inc.

Dead load was reduced in the rebuilding of the San Jacinto Hotel into a modern office building. After stripping the building to its original steel frame, the heavy, arched concrete floors were replaced with Q-Floors (steel floor and race-way combined).



Sakowitz Building

Architect: Alfred C. Finn, F.A.I.A.
Interior Architect: Brachstien Inc.
Gen. Contr.: Tellepsen Constr. Co.
Elec. Engr.: Reg. F. Taylor
Elec. Contr.: J. S. Copeland Electric Co.
Owner: Sakowitz Bros.

G-E Q-Floor wiring gives this department store complete electrical coverage for display window, show case, and office lighting.

You can put your confidence in—
GENERAL  ELECTRIC

"G-E Remote-Control Wiring goes in with real speed at low cost"



... says Clyde Grubb of Globe Electric, Dallas

"When the James A. Crow Company, Dallas, asked for wiring bids on their houses at Lake Park Estates, one of the features was G-E remote-control," said Clyde Grubb, Globe Electric. "When I figured costs for the bid, I was surprised to discover that remote-control wiring can be installed economically."

"Globe Electric got the contract for \$50 per house more than we usually bid on a conventional wiring job for houses in this price range," said Mr. Grubb. "These houses sell for \$25,000 to \$40,000."

"As my men became familiar with remote-control wiring," Mr. Grubb continued, "I was more than pleased to find them making real speed. It didn't take them long. The lightweight control wire for the switches can be stapled to the framing," said Mr. Grubb. "This helps make the work go fast and keeps costs down to a very reasonable figure." He concluded, "I'd say G-E remote-control goes in with real speed and at a surprising low cost."



"G-E Remote Control Wiring helped me sell \$2,000,000 in homes"

"We added a real selling tool to our Lake Park Estates project in Dallas when we decided on G-E remote-control," says builder James D. Crow of James A. Crow and Company. "We've featured remote-control in our advertising and made it a part of our selling program. Most important, our home buyers are completely sold on G-E remote-control," concludes Mr. Crow.

WHAT G-E REMOTE CONTROL IS

G-E remote control is the low-voltage modern wiring system that permits you to have as many ON-OFF controls of any light or outlet as you wish . . . including master switches, each of which will turn ON or OFF nine lights or outlets from one location. It adds convenience and safety . . . is economical for residential or commercial buildings.

Contractors Manual—Thirty-six page manual gives you all the facts—layout, wiring diagrams, and important installation hints. See your Construction Materials distributor, or write Section D44-718, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

You can put your confidence in—

GENERAL  ELECTRIC



TESTING TIPS

for the maintenance
of plant equipment

Lever Brothers Co. Cuts Testing Time 25% With Hook-on Wattmeter for Overload Tests

Lever Brothers Company, manufacturers of soap, edible products, and detergents, were able to cut testing time 25% by using the General Electric AK-2 hook-on wattmeter. They use the wattmeter to check power input in electrical equipment, and to check against overloads.

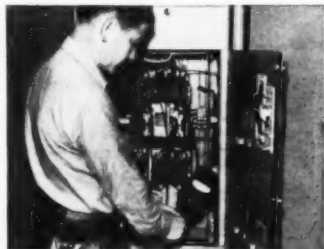
NO CUTTING OF CONDUCTORS

To measure power merely clamp the hook-on wattmeter around the line—no cutting of conductors, no costly shut-downs to make necessary power checks. Single-phase and polyphase circuits measured quickly and easily; in addition to kilowatts, vars in balanced three-phase circuits can be measured.

WIDE VERSATILITY

The AK-2 hook-on wattmeter can be used to make motor load tests, plant load surveys, to check resistance of elec-

tric furnaces, to measure kilowatts directly in overloaded areas, and in many other applications. The versatility of instrument is indicated by the fact that it will measure up to 300 KW, from 15-600 amperes, and from 100-600 volts—all at an accuracy of $\pm 5\%$ full scale. Price: \$87.00.* Order Bulletin GEC-591.



Pasadena Power and Light Praises G-E Portable Recorder Flexibility

Use of the General Electric CF-1 portable recorder by Pasadena Power & Light Co., has resulted in satisfactory voltage checks, reports A. Leonard Stevenson, relay tester.

REGULATORS CHECKED

Mr. Stevenson, shown in the photo above, says that regulator relays "are checked once a month to maintain standard voltages. Located in distribution centers for circuits, our CF-1's check the regulators to see that they are correctly compensated. The recorders are used whenever a circuit cut is made for adding or decreasing power. This instrument is more accurate than those previously used—its flexibility and adaptability make it a thoroughly satisfactory instrument."

30-DAY CHARTS AVAILABLE

You can get accurate records over an extended period of time with a G-E Type CF inkless recorder. Designed for dependability and maximum convenience, it can run as long as 30 days without attention, and has a weather seal for outdoor service. Simply put it on the line; it records volts, amps, or single-phase watts—just the information you need to determine what corrective action is necessary. The CF inkless recorder has an accuracy up to $\pm 1\frac{1}{2}\%$ per cent of full scale value. Price of voltmeter (0-140/280 volts): \$110.00.* More details in GEC-215.

G-E Insulation-resistance Meter Cuts Rejections Due to Insulation Failure



during the manufacture of electrical equipment.

PREVENTATIVE TESTS NEEDED

By testing insulation-resistance before making high potential tests (which are essential in many production operations), you avoid destruction of electrical equipment that has faulty insulation. High potential tests will do this if insulation is poor. The insulation resistance meter is particularly useful in testing the insulation of plant equipment—thus providing for prompt performance of preventative maintenance, which in turn reduces costly production interruptions.

EASY TO USE

The G-E insulation-resistance meter is small, compact, portable—thus convenient for production and service testing. Operated by one person, the meter is simple to use. Price: \$304.20.* Write for Bulletin GEC-753. General Electric Company, Schenectady 5, New York.

*Manufacturer's Suggested Retail Price.

REDUCTION OF REJECTS due to insulation failure is easily accomplished with a General Electric insulation-resistance meter.

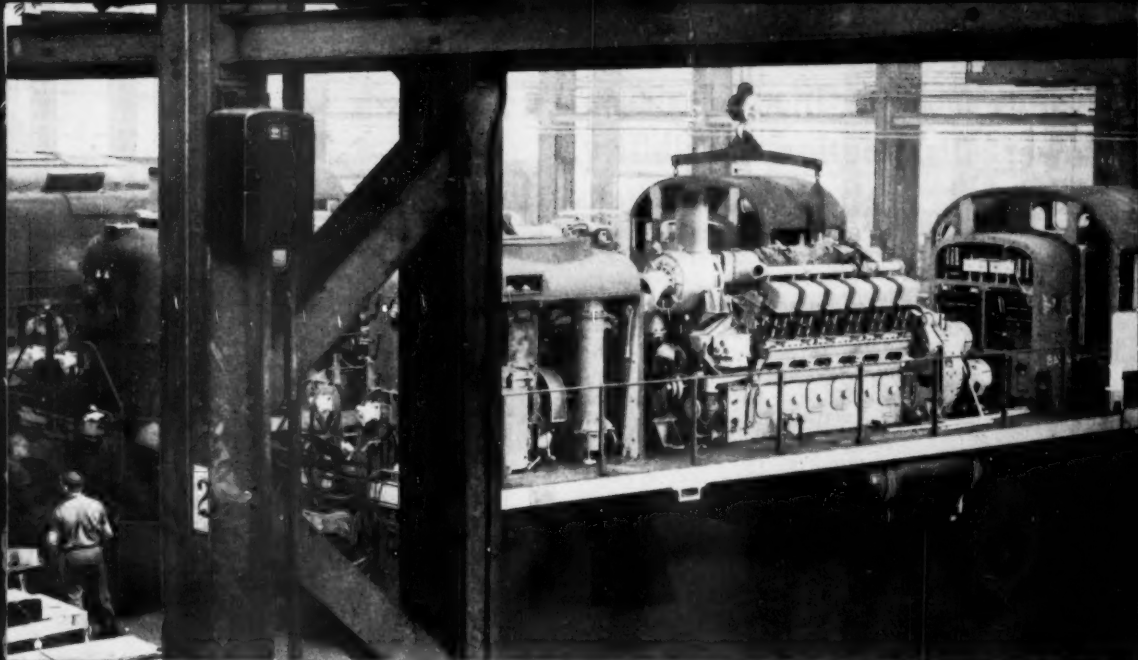
SAFER TO OPERATE

Safer to operate, the maximum output current being limited to two milliamperes, the meter can be used wherever 115-volt, 50- or 60-cycle power is available. The meter measures insulating-resistance over a range of 0-20,000 megohms, and is extremely valuable in detecting faults

GENERAL  **ELECTRIC**

When ordering bulletins, write to
Section 602-239, General Electric
Company, Schenectady, N. Y.

BUY NOW
From Your Nearest
G-E Distributor



COLUMN-MOUNTED Dry-Type Transformers at American Locomotive Company, Schenectady, N. Y., save floor areas for machines and

materials. These Type M's supply proper voltage for high-bay lighting at final assembly operation on diesel-electric locomotives.

How to save power dollars in your industry with G-E Dry-Type Transformers like these

Throughout industry, wherever machines, lighting or portable tools require voltage changes, you'll find G-E Dry-Type Transformers saving power dollars.

They save by putting the right voltage close to the load. By eliminating long runs of low-voltage secondary feeders, these transformers cut power losses, conserve copper.

And you can mount lightweight G-E Transformers on platforms or wall brackets

to save valuable floor space. Solderless connectors on the higher ratings simplify installation—no more splicing, soldering or taping.

G-E Dry-Type Transformers can save power dollars in your industry, too. Ask your nearby authorized G-E distributor to show you how. Or write for bulletin GEC-868A, Section 411-104, General Electric Company, Schenectady 5, New York.

GENERAL  **ELECTRIC**

PLATFORM-MOUNTED bank of G-E Type D Transformers provides correct power at the

load for sewing machines at Burton-Dixie Corporation, mattress manufacturer in Dallas.



PORTABLE-MOUNTED G-E Transformers at Kaiser wartime shipyards supplied low-voltage power where needed.



FEEDRAIL Heavy Duty Trolley Busway Mobility Offers Maximum Power Distribution Flexibility

The Feedrail Heavy Duty Trolley Busway Systems furnish the flexibility so necessary for internal power transmission. The systems are rated 250, - 375 or 500 amperes, 250 volts D.C. - 575 A.C., single phase or three phase. Standardized factory fabricated sections combine easily to give a "tailored to fit" power distribution system. The ability to quickly provide additional power take-off trolleys (rated 250 amperes) simplifies the problem of pre-planning. These up-to-date systems provide one of the best methods of handling long runs of heavy moving electrical loads.

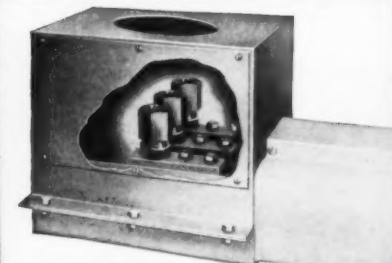
All current carrying parts are safely enclosed. This eliminates the hazards to workers and equipment that exist where exposed power conductors are used. It is far less expensive to install a fully protected Feedrail Heavy Duty Trolley Busway System than to lose production time because of serious accidents.

The Feedrail Heavy Duty Trolley Busway System provides a prefabricated movable power source for the lateral and transverse movement of heavy tonnage cranes and hoists. Welding equipment that must be moved from place to place can be put in operation immediately, for take-off trolleys of this system provide convenient power sources.

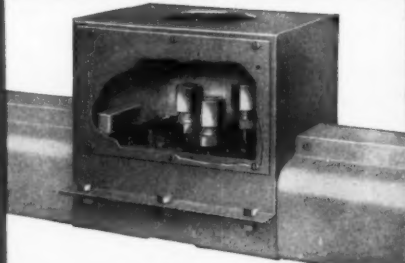
If you're operating with an outmoded system of power distribution you're paying for a modern Feedrail Heavy Duty Trolley Busway System without getting it. Consider these advantages:

1. The cost of installing the Feedrail Heavy Duty Trolley Busway System will be more than offset by the continued savings that will be realized.
2. All live parts are safely enclosed fully protecting workers and equipment.
3. Standardized units can be joined together to give a flexible arrangement to meet difficult power distribution problems: A dependable and continuous power source that is available at a moment's notice. Constructed so that infrequent maintenance is all that is necessary. The mobility of the power take-off trolleys eliminates the expense and delay of wiring new outlets.

Feed Boxes equipped with pressure type terminals simplify connecting lead-in power cables. Standardized design permits interchanging a Center Feed Box with Coupling Set at a joint and an End Feed Cap with a Dead End Cap at ends of a track run.



END FEED BOX



CENTER FEED BOX

**YOUR
POWER SOURCE
CAN
Roll
WITH YOUR
EQUIPMENT**

More productive plant layouts and methods planned with assurance that a flexible power source will be immediately available.

4. Standardized units allow for future expansion of the power distribution systems to match plant growth, new production layouts or methods. The whole system can be dismantled and reassembled in another location, re-using all original units. This helps to keep expenditures for plant additions to a minimum.

5. Short overhead cable connections keep work areas and aisles clear for the free movement of material in process. Floor space can be utilized to better advantage.

Lets' talk it over...

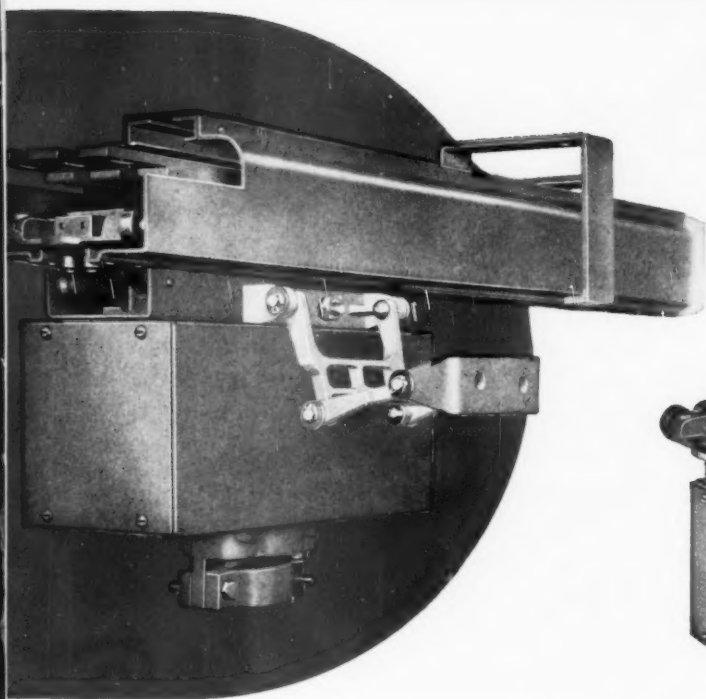
We invite discussion with our engineering staff as to the possible applications of the Feedrail Heavy Duty Trolley Busway System to your particular problem. There's no obligation on your part.

Write to Department H.D.27

FEEDRAIL CORPORATION, 125 Barclay St., New York 7, N. Y.

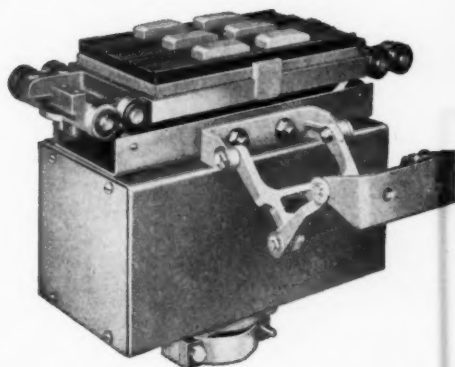
FEEDRAIL CORPORATION

Subsidiary of Russell & Stoll Company, Inc.



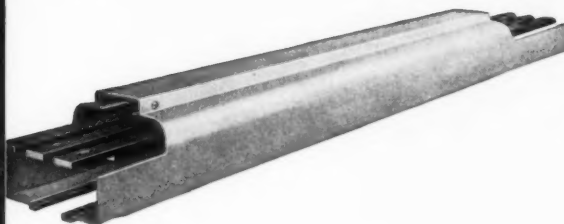
Detail view of assembled track, trolley and track hanger. The rugged construction of the Feedrail Heavy Duty Trolley Busway System is ideally suited to the continuous transmission of power to movable electrical equipment. Every provision for safety has been incorporated in the design.

Track and track accessories are standardized and similar type units are interchangeable. The combined result is a highly flexible system that can be adapted to meet the particular requirements for the safe delivery of high capacity current. Modification or expansion present no problem and all original units can be re-used.



Trolley with terminal box and pantograph linkage.

The brush type silver tungsten faced bevelled contacts assure constant pressure and alignment with the bus bars. At either end of the trolley, undercarriage wheels prevent upthrust and horizontal wheels prevent side slewing. Terminal box is equipped with lug screw type connectors and cable grip. Pantograph linkage provides a positive strain-free attachment for bolting trolley to movable electric equipment to be powered.



Plain Track. Sturdy one piece steel track with rust repellant finish safely encloses heavy current carrying bus bars held on arc-resistant insulators. Provision has been made for unequal expansion and contraction between the copper bus bars and the steel track housing. Door track sections are furnished to permit trolleys to be inserted quickly and safely.

In addition to Feedrail Heavy Duty Systems the FEEDRAIL CORPORATION manufactures and markets:

FEEDRAIL "60", SYSTEMS

60 ampere, 250 volt D.C., or A.C., single or three phase

FEEDRAIL "100", SYSTEMS

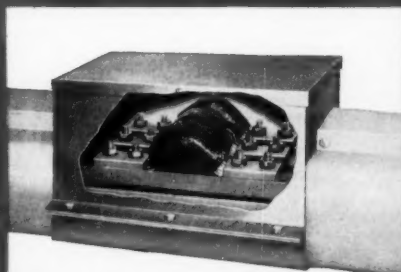
100 ampere, 250 volt D.C. or 575 A.C., single or three phase

FEEDRAIL MULTIPLE CONDUCTOR SYSTEMS

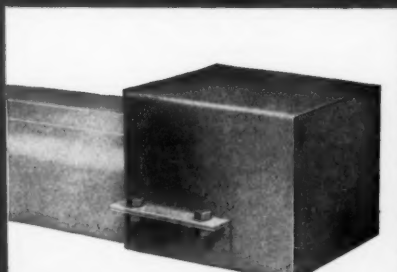
for power and control.

Coupling Sets join and align adjacent track sections. Flexible braided copper straps bolted to the ends of lapping bus bars maintain a full flow of current across joints.

Dead End Caps close the end of runs and prevent trolleys from leaving track.



COUPLING SET



DEAD END CAPS



COPE Cable Trough is Used by Utilities and Industrial Plants Throughout the World

The ease and economy of installing standard COPE Cable Trough has given it wide acceptance among the leading utilities and industrial plants around the globe. They realize, as will you, how COPE Cable Trough saves on time, material and costs.

COPE Cable Trough Installation at Gary Sheet & Tin Mill—U. S. Steel Company



A few of the Users of COPE CABLE TROUGH

Allis-Chalmers Manufacturing Co.
Aluminum Company of America
Atlantic City Electric Co.
Atomic Energy Commission
Borg-Warner Corp.
The Budd Company
Carolina Power & Light Co.
Central Hudson Gas & Electric Corp.
Cincinnati Gas & Electric Co.
Cleveland Electric Illuminating Co.
Commonwealth Edison Co.
Connecticut Light & Power Co.
Consolidated Gas, Electric Light & Power Co. of Baltimore
Delaware Power & Light Co.
Detroit Edison Co.
Detroit Steel Corp.
Dow Chemical Co.

E. I. du Pont de Nemours & Co., Inc.
Ethyl Corporation
Ford Motor Company
Goodyear Tire & Rubber Co.
Indianapolis Power & Light Co.
International Harvester Co.
Island of Iceland
Jersey Central Power & Light Co.
Jones & Laughlin Steel Corp.
Kaiser Aluminum & Chemical Corp.
Kansas City Power & Light Co.
Kingdom of Egypt
Kingdom of Greece
The Mead Corporation
Monsanto Chemical Co.
Monongahela Power Co. and The Potomac Edison Co.
National Advisory Committee for Aeronautics
National Aniline Div., Allied Chemical & Dye Corp.

New York State Electric & Gas Corp.
Niagara-Mohawk Power Corp.
Pacific Gas & Electric Co.
Packard Motor Car Co.
Pennsylvania Electric Co.
Philadelphia Electric Co.
Pittsburgh Plate Glass Co.
Republic Steel Corp.
Reynolds Metals Co., Inc.
Southern California Edison Co.
Union Electric Co.
United States Army—Corps of Engineers
United States Bureau of Reclamation
United States Navy
United States Steel Co.
Virginia Electric & Power Co.
WCAU—AM-FM-TV, Phila.
Western Electric Co., Inc.

For Most Cable Trough Installations . . .

Our exhaustive list of standard COPE Cable Trough parts can easily be worked into your plans. The simplified design of standard COPE Cable Trough actually saves you three ways — materials, labor and costs.



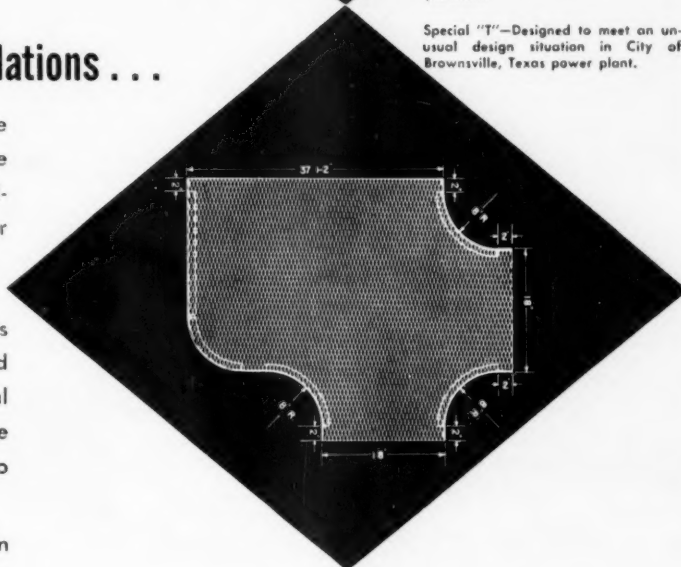
Standard Installation of COPE Trough at Danskammer Point Steam Station, Central Hudson Gas & Electric Corporation.

As Well As . . .

For Unusual Cable Trough Installations . . .

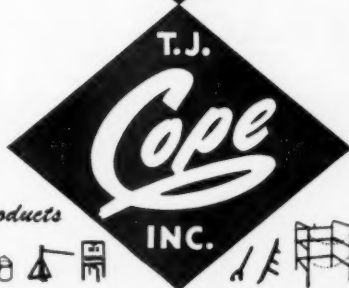
Where the standard COPE Cable Trough cannot answer those "special situations," COPE Engineers will help you with your problem. We will, as we have for hundreds of users, furnish special fittings. All we require is an outline of your problem and we will then design any special fittings necessary to adapt the standard COPE Cable Trough to your specific job.

Please request full information on standard COPE Cable Trough from us today.



Special "T"—Designed to meet an unusual design situation in City of Brownsville, Texas power plant.

**T. J. COPE, INC., 711 SOUTH 50th ST.
PHILADELPHIA 43, PENNSYLVANIA**



You know Cope by these products



Build Your Reputation by

MEET THE BIG EXISTING DEMAND FOR *Interlocking Wiring Devices*

WITH THE NEW, IMPROVED

ARROW

ELECTRIC DIVISION

HART-LOCK

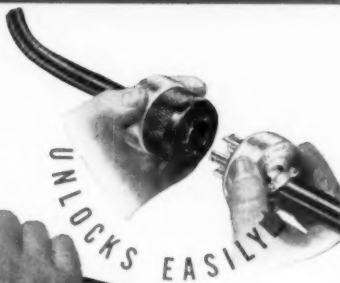
2-, 3- and 4-WIRE CAPS,
CONNECTORS, PLUG BASES, MOTOR BASES,
MOTOR PLUGS and FLUSH RECEPTACLES

Grounding types are available . . . all receptacles and connectors can be used with either polarized or non-polarized caps. Despite the many improvements in design and construction, HART-LOCK units can, if necessary, be interchanged with older types of interlocking devices.

Manufactured by THE ARROW-HART & HEGEMAN ELECTRIC CO.

20 AMPS
250 VOLTS, A.C.-D.C.
10 AMPS
575 VOLTS, A.C.

Positive Action



Wherever Separable Connections are needed

HART-LOCK

• PREVENTS UNINTENTIONAL DISCONNECTS FROM ANY ACCIDENTAL CAUSE • INCREASES SAFETY . . . ELIMINATES WASTE BY ASSURING A CONSTANT POWER SUPPLY • OFFERS YOU—AND YOUR CUSTOMERS—MORE IMPORTANT ADVANTAGES THAN ANY OTHER TYPE OF INTERLOCKING DEVICE NOW AVAILABLE



RESEARCH AND
PRODUCT
DEVELOPMENT



PRODUCTION LINES



MACHINERY



OFFICE EQUIPMENT

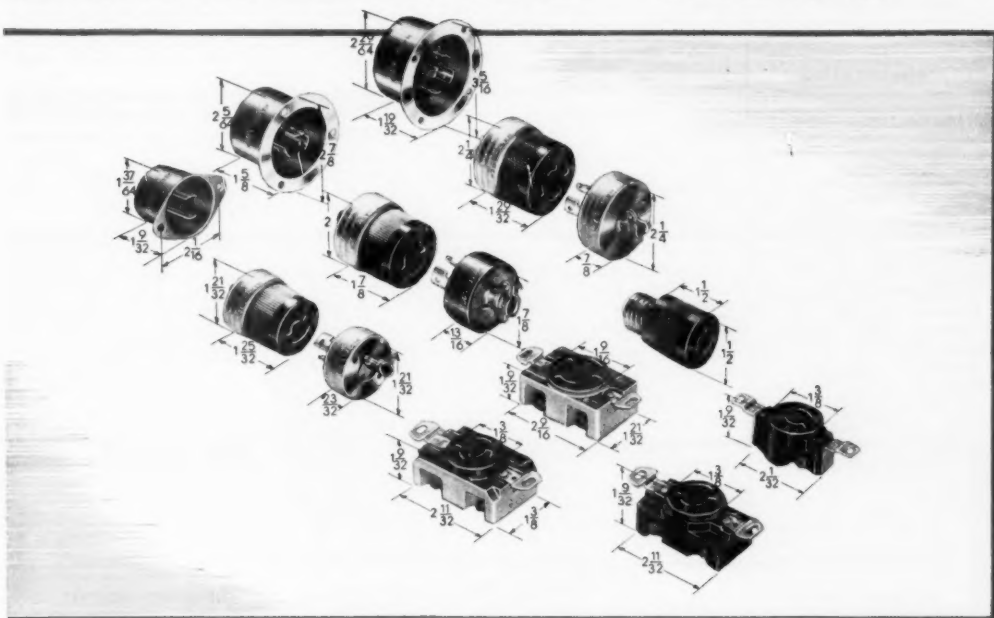


TEST EQUIPMENT



MAINTENANCE
EQUIPMENT

USING THE BEST

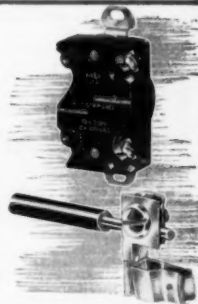


Check these Features

OPTIONAL WIRING— Back-wired and Side-wired receptacles are quicker and easier to install. The strong, secure connections are neater and safer with no exposed wire ends. A handy, Wire Strip Gauge on the back plate gives the exactly correct length for both back and side wiring.

EXCLUSIVE ONE-PIECE "CONTROLLED-TENSION" INNER CONTACTS — For greater electrical efficiency, minimum resistance, low loss. Heavy bronze U-type construction with single staking to mounting bracket is stronger . . . lasts longer.

HEAVY, RUGGED, HIGH QUALITY CONSTRUCTION — Body is of the best commercial Bakelite for use . . . porcelain is available for applications requiring high heat resistance. All conducting parts are heavy brass or bronze; ferrous metal parts are heavily zinc plated to resist corrosion.



Ask your local Electrical Distributor

TO SHOW YOU
THE NEW HART-LOCK

Logical source for the newer, better HART-LOCK — and all the other high quality wiring devices in our complete line — is your local electrical distributor. He is familiar with your needs and stocks the equipment and supplies you call for. You are assured of prompt, personalized service. Next time you need to order interlocking devices, stop in or phone your local distributor — and ask for HART-LOCK.



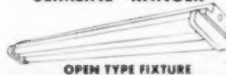
THE ARROW-HART & HEGEMAN ELECTRIC COMPANY
1707 LAUREL STREET
HARTFORD 6, CONNECTICUT

Branches in: BOSTON, CHICAGO, DALLAS, DENVER, DETROIT, LOS ANGELES, NEW YORK, PHILADELPHIA, SAN FRANCISCO, SYRACUSE. In Canada: ARROWHART & HEGEMAN (CANADA) LTD., MT. DENNIS, TORONTO 15, ONTARIO.

A DIGEST OF DAY-BRITE DATA

DIRECT TYPE FIXTURES

SLIMLINE "RANGER"



OPEN TYPE FIXTURE

LAMPS	FIXTURE DIMENSIONS	CATALOG NUMBER
NO. SIZE	LENGTH WIDTH HEIGHT	
2 75-W	95 1/2" 7" 4 1/4"	96260
2 60-W	71 1/2" 7" 4 1/4"	66260
2 40-W	47 1/2" 7" 4 1/4"	46260

RANGER DATA

APPLICATION—Unit or continuous. **MOUNTING**—Surface or suspension. **CONSTRUCTION**—Die-formed and welded heavy-gauge steel. **FINISH**—HOT-BONDED SUPER-WHITE enamel. **WIRING**—TURRET sockets. Instant start HPF 430-milliamperes Certified ballasts. UL approved.

1 © G. E. Co.

SLIMLINE "PLEXOLINE-2"



WITH LOW BRIGHTNESS NO. 9015 HOLOPHANE CONTROLS*

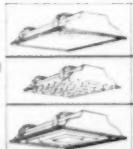
LAMPS	FIXTURE DIMENSIONS	CATALOG NUMBER
NO. SIZE	LENGTH WIDTH HEIGHT	
2 75-W	96 3/4" 12 3/4" 4"	97720
2 60-W	72 3/4" 12 3/4" 4"	67720
2 40-W	48 3/4" 12 3/4" 4"	47720

LENS PLEXOLINE DATA

APPLICATION—Unit or continuous. **MOUNTING**—Surface or suspension. **CONSTRUCTION**—Die-formed steel. One-piece enclosure and chassis. Reflector plates for 100% direct distribution. **SHIELDING**—No. 9015 Controls in separable hinged frames. **WIRING**—ETL Certified ballasts. Individually wired for unit, continuous, surface or suspension installation. UL approved.

FLUORESCENT "MOBILEX"

A NEW RECESSED LIGHTING SYSTEM FOR USE WITH GRID TYPE SUSPENDED CEILING



2-LAMP FLUORESCENT			3-LAMP FLUORESCENT			4-LAMP FLUORESCENT		
LAMP SIZE	FIXTURE DIMENSIONS	CATALOG NO.	LAMP SIZE	FIXTURE DIMENSIONS	CATALOG NO.	LAMP SIZE	FIXTURE DIMENSIONS	CATALOG NO.
20-W	24" x 24"	24372	20-W	24" x 24"	24372	20-W	24" x 24"	24472
40-W	24" x 48"	44372	40-W	24" x 48"	44372	40-W	24" x 48"	44472
20-W	24" x 24"	24382	20-W	24" x 24"	24382	20-W	24" x 24"	24482
40-W	24" x 48"	44382	40-W	24" x 48"	44382	40-W	24" x 48"	44482
20-W	24" x 24"	24392	20-W	24" x 24"	24392	20-W	24" x 24"	24492
40-W	24" x 48"	44392	40-W	24" x 48"	44392	40-W	24" x 48"	44492

MOBILEX DATA

APPLICATION—Single unit, end to end, side to side. **MOUNTING**—Recessed into grid type suspended ceiling. Fixture rests on interlocking "tees" which also support Fiberglas Ceiling Board. Flange type Mobilex also available for conventional ceilings. **SHIELDING**—Skytex glass panels, Boxco louvers, or moulded plastic panels. **FINISH**—HOT-BONDED SUPER-WHITE enamel. **WIRING**—Sockets, Certified ballasts and NO-BLINK type starters on 20-watt units. All 40-watt units furnished with RAPID-SMOOTH START ballasts. UL approved.

ALZAK PARABOLIC



FLANGE TYPE SHOWN

FLANGE TYPE			SNAP-IN TYPE		
LAMPS	FIXTURE LENGTH	CATALOG NO.	LAMPS	FIXTURE LENGTH	CATALOG NO.
2 75-W	96"	92275-8	2 75-W	96"	92265-8

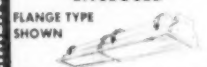
11-INCH CURVED CONTROLLENS*



FLANGE TYPE SHOWN

LAMPS	FIXTURE LENGTH	CATALOG NUMBER	LAMPS	FIXTURE LENGTH	CATALOG NUMBER
2 75-W	96"	93225-8	2 75-W	96"	93215-8
3 75-W	96"	93325-8	3 75-W	96"	93315-8

HINGED GLASS ENCLOSED



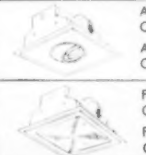
FLANGE TYPE SHOWN

Same basic channel available with three other interchangeable shielding elements:
(1) Egg crate louvers
(2) BOXCO LOUVERS
(3) No. 9015 DB Control Lens*

LAMPS	FIXTURE LENGTH	CATALOG NUMBER	LAMPS	FIXTURE LENGTH	CATALOG NUMBER
2 75-W	96"	92235-8	2 75-W	96"	92230-8
3 75-W	96"	92335-8	3 75-W	96"	92330-8

SLIMLINE TROFFERS

TROFFER ACCENT UNITS



ADJUSTABLE—FLANGE TYPE	CATALOG NO.
ADJUSTABLE—SNAP-IN TYPE	CATALOG NO.
FIXED—FLANGE TYPE	CATALOG NO.
FIXED—SNAP-IN TYPE	CATALOG NO.

FOR	CATALOG NO.
Accent Unit—12"x12"	7770
4-ft. Troffer Units	7771
8-ft. Troffer Units	7771-8

PLASTER FRAMES

Die-formed "T" formation provides rigid strength. Holes in rails for wiring to furring channel. Spacer bars maintain correct framed opening during plastering.



TROFFER DATA

PARABOLIC
Diffuse Alzak aluminum troffers provide low brightness contrast. Center "V" lower and lateral louvers interlocked for strength. Available also in all-white finish, in standard fluorescent and with fill-in sections.

CURVED CONTROLLENS*
Includes 11-inch wide (No. 9030 Intermediate and 9031 End) Control Lens. Lens lock prevents accidental displacement of control lens. Available also in standard fluorescent. Fill-in sections available.

HINGED SERIES
Four shielding elements available: ribbed Skytex glass panels, Boxco louvers, egg-crate louvers and low brightness 9015-DB Control Lens. Each shielding element is separately hinged, allows hinging from either side. Also available in standard fluorescent. Fill-in sections available.

GENERAL
CONSTRUCTION—Die-formed through-out. Removable wiring cover. Continuous wiring channel. **FINISH**—HOT-BONDED SUPER-WHITE enamel. **WIRING**—sockets, ETL Certified ballasts. **RAPID-SMOOTH START** ballasts on fluorescent units. UL approved.

ONE-LAMP RECESSED DUO-FRAME UNITS



WITH HOLOPHANE CONTROLS*

* © Holophane Co., Inc.



LAMP SIZE	LENS SIZE	DEPTH	WIDTH	LENGTH	CATALOG NUMBER
150W	8 1/2"	7"	10 1/2"	10 1/2"	RS-851-RV
150W	8 1/2"	9 1/2"	10 1/2"	10 1/2"	RS-851-RHV
200-300W	12"	9"	14 1/2"	14 1/2"	RS-121-RH
200-300W	12"	11 1/2"	14 1/2"	14 1/2"	RS-121-RHV

DUO-FRAME DATA


Die-formed, riveted and welded construction. Two-piece frame. Inner frame mounted to drop hinges—opens easily for servicing. Vertical lamp mounting units (RV) have Holophane prismatic glass reflectors. Horizontal lamp mounting units (RH) have specular Alzak reflectors. Porcelain sockets. UL approved. Four feet of flex with wire and box connector furnished with all fixtures.

A HANDY SPECIFYING CHECK-LIST


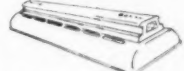

SEMI-DIRECT FIXTURES

SLIMLINE "LUVEX" 2- AND 4-LAMP	8" SUSPENSION			24" SUSPENSION			LUVEX DATA
	FIXTURE LENGTH	CUT-OFF	CATALOG NUMBER	FIXTURE LENGTH	CUT-OFF	CATALOG NUMBER	
	96 1/2"	STANDARD	96266-8	96 1/2"	STANDARD	96267-8	APPLICATION —Unit or continuous. MOUNTING —Recommended for suspension only. CONSTRUCTION —Die-formed and welded steel. All metal. One-piece enclosure with interlocked louvers. FINISH —HOT-BONDED SUPER WHITE enamel. WIRING —ETL Certified ballasts. Individually wired. UL approved. Fill-in sections available. 2-Lamp 40-watt fluorescent Luvex also available.
	96 1/2"	35/45	96296-8	96 1/2"	35/45	96297-8	
	96 1/2"	STANDARD	96468-8	96 1/2"	STANDARD	96469-8	
	96 1/2"	35/45	96498-8	96 1/2"	35/45	96499-8	
FLUORESCENT "VIZ-AID"	STANDARD FINISH			ALL WHITE FINISH			VIZ-AID DATA
	LAMPS	FIXTURE LENGTH	CATALOG NUMBER	LAMPS	FIXTURE LENGTH	CATALOG NUMBER	
	2 40-W	49"	46202-4	2 40-W	49"	46230-4	
	4 40-W	49"	46432-4	4 40-W	49"	46462-4	
	2 85-W	61"	55202-5	2 85-W	61"	55232-5	APPLICATION —Unit or continuous. MOUNTING —Surface or suspension. CONSTRUCTION —Die-formed and welded steel. Interlocked louvers. Alabite glass side panels. FINISH —(Standard) Specular Alzak V-center louver. Lateral louvers and chassis in SUPER-WHITE. Enclosure frame in lustre aluminum. (All white) HOT-BONDED SUPER WHITE enamel throughout. WIRING —RAPID SMOOTH START ballasts. Individually wired. UL approved.
SLIMLINE "PLEXOLINE" 2- AND 4-LAMP	LAMPS			LAMPS			LOUVERED PLEXOLINE DATA
	LENGTH	WIDTH	DEPTH	LENGTH	WIDTH	DEPTH	
	2 75-W	96 1/2"	12 1/4"	4"	96 1/2"	12 1/4"	
	2 60-W	72 1/2"	12 1/4"	4"	72 1/2"	12 1/4"	
	2 40-W	48 1/2"	12 1/4"	4"	48 1/2"	12 1/4"	APPLICATION —Unit or continuous. MOUNTING —Surface or suspension. CONSTRUCTION —Die-formed and welded steel. Enclosure and chassis in one piece, removable louvers completely interlocked. Reflector plates furnished for surface mounting, providing 100% direct distribution. Alabite glass side panels. FINISH —HOT-BONDED SUPER WHITE enamel. WIRING —ETL certified ballasts. Individually wired. UL approved. Fill-in sections and luminous side circular accent units also available for unlimited lighting patterns. Louvered Plexoline also available in standard fluorescent.
	4 75-W	96 1/2"	21"	4"	96 1/2"	21"	
	4 60-W	72 1/2"	21"	4"	72 1/2"	21"	
	4 40-W	48 1/2"	21"	4"	48 1/2"	21"	


SEMI-INDIRECT FIXTURES

PBM 	TYPE—FLUORESCENT	PBM DATA APPLICATION —Unit or continuous. MOUNTING —Suspended only. CONSTRUCTION —Die-formed and welded steel. Wireway mounts to ceiling and supports ballasts and adjustable "A-J" hanger stems. Standard hanger lengths position fixture approximately 21" below the ceiling. Fully enclosed cylindrical sections are two-piece; lower half is diffuse plastic and upper half is clear plastic. High efficiency, low maintenance factor. FINISH —HOT-BONDED SUPER WHITE enamel. WIRING —RAPID-SMOOTH START ballasts and sockets furnished. UL approved.
	LAMPS—2/40-W	
	FIXTURE LENGTH—52 1/4"	
	CATALOG NO.—45230-4	

INDUSTRIAL FIXTURES


SLIMLINE CFI DAY-LINE				CFI DAY-LINE DATA	
	OPEN END	LAMPS	FIXTURE LENGTH	CATALOG NUMBER	
		2 75-W	95 1/2"	R5-91281-8	
		3 75-W	95 1/2"	R5-91381-8	
FLUORESCENT CFI DAY-LINE	OPEN END	2 40-W	49 1/2"	R5-40281-W	APPLICATION —Unit or continuous. SUSPENSION —Pipe, chain, stem or messenger cable mounting. CONSTRUCTION —Channel die-formed from 20 gauge steel stress-engineered to resist vibration and shock. One-piece reflectors die-stamped from special enameling iron. Embossed apertures in reflector provide 10% distribution of light upward to lessen brightness contrast and improve visual comfort. CFI means "COMFORT FOR INDUSTRY." FINISH —Channel in gray aluminum. Reflector in flint-hard, everlasting white porcelain enamel—inside and outside. WIRING —(Slim-line) Instant-start ETL Certified ballasts. (Fluorescent) RAPID SMOOTH START ballasts. Heavy duty TURRET sockets on all CFI DAY-LINE units. UL approved.
		3 40-W	49 1/2"	R5-40381-W	
		2 85-W	61 1/2"	R5-50231-W	
	CLOSED END	2 40-W	52 1/4"	R5-40291-W	
		3 40-W	52 1/4"	R5-40391-W	
		2 85-W	66"	R5-50221-W	
					
	HYDEE HANGER			CATALOG NO.	
	HYDEE Hanger with two 5-ft. chains, "S" hooks receptacle and cord clips			9988	

"A-J" ADJUSTABLE HANGER

	LENGTH	CATALOG NO.
	24"	3314-A
	8"	3318-A

Swivel fittings. Over 1" vertical hand-operated adjustment. Hot-Bonded lustre aluminum enamel finish.

EXIT SIGNS

	SURFACE MOUNTING	
	SINGLE FACE	
	13 ³ / ₁₆ " x 9 ¹ / ₁₆ " x 4 ³ / ₁₆ "	
	6" LETTERS	
	CATALOG NO. 3116	

Complete line. Units available for surface, recessed, top and end mounting. Solid or glass bottom. Metal stencil faces, 6" letters without arrow, 5" letters with arrow left, arrow right or double arrow. Red glass. Baked lustre aluminum finish. Two porcelain sockets for 25-watt A-19 lamps.

SEE YOUR NEAREST DAY-BRITE DISTRIBUTOR

Your Day-Brite distributor can give you complete information about the items listed on these pages. He carries many of them in stock. A Day-Brite specification is always a guarantee of profitable business. It pays to

standardize on Day-Brite. Day-Brite Lighting, Inc., 5402 Bulwer Ave., St. Louis 7, Missouri. In Canada: Amalgamated Electric Corp., Ltd., Toronto 6, Ontario. Distributed only by leading electrical wholesalers.

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BULLDOG Reduces

No change whatsoever in products, no sacrifice in quality! Install genuine Pushmatic Circuit Breakers, Electri-Centers, Accessories at up to 35% less!

Yes, all Pushmatic prices have been drastically reduced!

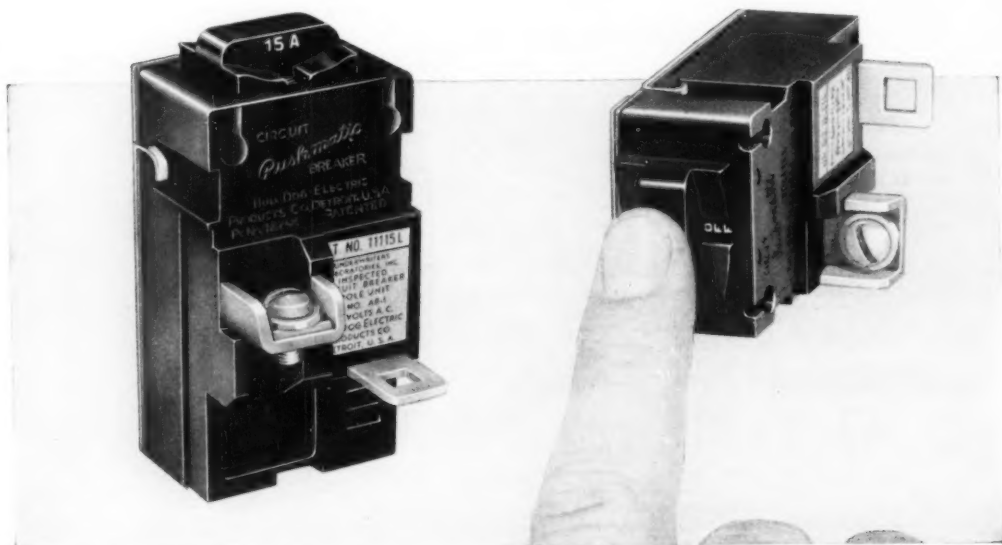
You can save up to 35% on full-quality Pushmatic® Circuit Breakers, Electri-Centers and Accessories. Get all the famous Pushmatic features at prices paid for ordinary circuit breaker equipment. Now you don't have to settle for anything less than Pushmatic quality in your lighting panels.

Popular demand, plus new production facilities, makes these reductions possible on genuine Pushmatic equipment. A new BullDog plant (Bellefontaine, Ohio) is devoted exclusively to producing the Pushmatic line. Production is up, costs are

down . . . you share in the savings when you buy Pushmatic.

Get immediate delivery on panelboards to fit exact needs and specifications. Types P2B and P3B Electri-Centers handle industrial lighting up to 42 circuits. Types XD and PB Electri-Centers, up to 18 circuits, handle lighting and service equipment in homes, smaller plants. Service Electri-Centers, up to 8 circuits, for lighting in homes and shops.

Compare Pushmatic at new low prices; then stock and install the BullDog line. Write for information-packed Bulletins 513 and B-360.



JUST PUSH THE BUTTON!

Famous, foolproof Pushmatic Circuit Breakers are individual, interchangeable units that provide automatic, trip-free circuit protection always. Rupture circuits instantly when trouble occurs. Need no resetting. A simple push restores service. Available in 15, 20, 30, 40 and 50 amps.; identical

in appearance, dimensions; give unmatched flexibility to all BullDog Electri-Centers. Easy to stock; packaged separately. Guaranteed. Listed by Underwriters'.

NEW LOW PRICE!

Pushmatic Prices!



P2B Electric-Centers

with Pushmatics for industrial, office lighting. Immediate delivery on any panel requirement up to 42 circuits from just five basic devices. Install easily, quickly with simple tools.

NEW LOW PRICE!



XD Electric-Centers

for homes, small businesses. Feature split bus bars, Pushmatic protection, one central control for all home circuits, both service equipment and lighting. Accommodate up to 18 circuits.

NEW LOW PRICE!



Service Electric-Centers

also equipped with modern, safe Pushmatic Circuit Breakers. Adapt quickly, easily to customers' present and future needs. Will handle up to 8 circuits. Attractive, compact appearance.

NEW LOW PRICE!



Individual, Interchangeable

Pushmatic units can be added or removed in minutes to meet changes in circuit requirements. Rugged Pushmatics bolt to bus bars quickly, never shake loose, need no servicing.

NEW LOW PRICE!

CHECK THESE ADVANTAGES of

Bulldog Pushmatic Electric-Center Panels

- For plants, commercial buildings, institutions, homes.
- Push-button switching and automatic circuit protection. No reset position.
- Underwriters'-listed up to 42 circuits.
- Individual Pushmatic units (Thermal Magnetic) rated 15, 20, 30, 40 and 50 amps.; quick-mounting, fully interchangeable.
- Meet Federal Specifications WP 131a Class A.
- Wide gutters for easy wiring.
- Code Gauge steel fronts, flush or surface type.
- Code Gauge steel boxes with ample knockouts in removable ends.
- Provision for Main Lugs at top or bottom.
- Flexible from every standpoint.

BULLDOG ELECTRIC PRODUCTS COMPANY

DETROIT 32, MICHIGAN • FIELD OFFICES IN ALL PRINCIPAL CITIES
IN CANADA: BULLDOG ELECTRIC PRODUCTS OF CANADA, LTD., TORONTO

PIONEERS IN FLEXIBLE ELECTRICAL DISTRIBUTION SYSTEMS

BULLDOG



1902-1952 . . . SERVING INDUSTRY FOR 50 YEARS WITH FINER ELECTRICAL PRODUCTS

SAFE, DEPENDABLE POWER and LIGHT CONTROL ... for *all* types of buildings with Products



RESIDENTIAL



COMMERCIAL





INDUSTRIAL



HOSPITALS AND INSTITUTIONS

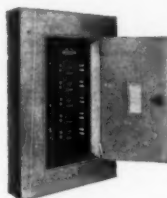
Safe, Dependable Power and Light Control is an absolute necessity in all types of buildings — whether it's a small home, store, office or other commercial building, a large industrial plant, school, hospital or other institution.

 *Has been Producing Equipment* for the control and distribution of power and light for more than 60 years — electrical products that have been tested and proven to measure up to the highest standards of safety, efficiency and dependability — products that are economical, and will give long-lasting and trouble-free service.

The Next Time a job involves power and light distribution and control — whether it's a small load center or service equipment, or a large switchboard, panelboard, busduct or other unit — use . You'll find it pays handsome service dividends.



SWITCHBOARD



LNTP
PANELBOARD



THERMAG
PANELBOARD



POWERPLUGIN



MIDGET
POWERPLUGIN



FEEDER
PANELBOARD



DUSTITE
PANELBOARD



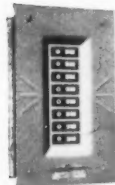
SHUTLBRAK
SWITCH



MAIN AND
RANGE UNIT





QUIKHETER




ADD-ON
LOAD CENTER



COLUMN TYPE
PANELBOARD

The illustrations above are typical of the many  products available for the control and distribution of power and light. While most  products are of a standardized nature, the Company is prepared to provide specialized equipment to meet specific needs.

For further information contact your nearest  representative, listed in Sweets, or write to headquarters.

Frank Adam Electric Co.

P. O. BOX 357 ST. LOUIS 3, MISSOURI

Makers of BUSDUCT • PANELBOARDS • SWITCHBOARDS • SERVICE
EQUIPMENT • SAFETY SWITCHES • LOAD CENTERS • QUIKHETER



7 important NEW features

... to the many basic advantages of



A
Nationwide
Distribution
Through Electrical
Wholesalers

CONDULETS

TRAFFIC SIGNALS

have been added **CROUSE-HINDS** Type EPC motor starter and circuit breaker **CONDULET** *

You get all of them on the Model M52

Model M52 EPC is the most flexible explosion-proof line starter and circuit breaker enclosure ever produced. The addition of 7 new features to the proven basic advantages of the EPC construction assures the greatest ease of installation and maintenance.

The exclusive basic advantages of the EPC Condulet have made it the world's leading enclosure for housing motor starters, circuit breakers and combinations for use in hazardous locations.

The basic advantages are:

EASY INSTALLATION . . . The use of a strong light-weight aluminum alloy and the unique three-section design makes it practical for an electrician and his helper to install the largest housing without the use of costly lifting equipment. The internal devices can be easily removed for pulling in the wires.

THREADED JOINT CONSTRUCTION . . . All joints are threaded. All operating shafts and bushings are thread-in-thread construction. This insures maximum safety, easy inspection and

maintenance, and maximum corrosion protection.

FLEXIBILITY . . . A large number of different enclosures can be assembled from the wide variety of sizes of bodies and covers. They are not only used for circuit breakers and starters but have proven adaptable for many other types of electrical equipment. The body has numerous conduit hubs for flexibility of installation.

COST AND TIME SAVINGS . . . The outstanding advantages of the unique EPC Condulet over conventional explosion-proof enclosures all add up to lower installed cost and lower maintenance cost.

All of these advantages have been available for years.

Now Crouse-Hinds offers you 7 new improvements to underline the basic advantages of type EPC Condulets and to save you more dollars and more man-hours than ever before.

- ① **Built-in Push button stations** available on line starters and combinations of line starters with circuit breakers — START — STOP, FOR — REV — STOP and HIGH — LOW — STOP stations for regular, reversing, or two-speed starters.
- ② **Built-in selector switch** is available on line starters and combinations of line starters with circuit breakers. Normally supplied marked HAND — OFF — AUTO or JOG — RUN — OFF, three-position style. Two-position selector switch or combinations of selector switch with START — STOP station can be supplied.
- ③ **Back conduit entrance** can be supplied by drilling and tapping the boss in the center of the back . . . in addition to the four regular top and bottom hubs.
- ④ **Protective Neoprene gasket** is available for the upper cover joint. Where EPC Condulets are exposed to unusually severe weather or corrosive conditions, this gasket provides additional protection.
- ⑤ **A new RESET lever with threaded shaft**, rotating within a threaded bushing, provides easier and more positive operation of the reset mechanism.
- ⑥ **Horizontal through-feed conduit entrances** are provided by drilling and tapping bosses on the sides of the Condulet body.
- ⑦ **Greater ease in wiring** is provided by increased height in the center body section and by universal use of open framework mountings for circuit breakers and starters in the new model M52 EPC Condulets.



Model M52
Type EPC Explosion-Proof
Condulet in 7, 9, and 11-inch
body size

Send for YOUR copy of Bulletin 2634 →

*CONDULET is a coined word registered in the U. S. Patent Office. It designates a product made only by the Crouse-Hinds Company.

CROUSE-HINDS COMPANY
Syracuse 1, N. Y.

OFFICES: Albuquerque — Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Indianapolis — Kansas City — Los Angeles — Milwaukee — Minneapolis — New York — Philadelphia — Pittsburgh — Portland, Ore. — San Francisco — Seattle — St. Louis — Tulsa — Washington. RESIDENT REPRESENTATIVES: Albany — Atlanta — Baltimore — Charlotte — New Orleans — Richmond, Va. Crouse-Hinds Company of Canada Ltd., Toronto, Ont.



AIRPORT LIGHTING

FLOODLIGHTS

features of CODE METER BOXES

1 Costs Less . . . as installation can be made in about one half the time. Ample wiring room.

2 Continuous Service, even while meter is being removed or tested.

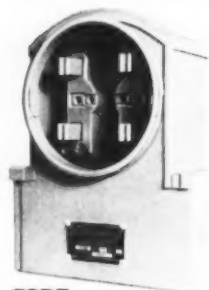
3 Safe . . . no wires behind meter to cause shorts or grounds.

4 Construction eliminates any chance for water or condensation getting behind meters. Extra knockouts for adding other services, ground conduits or time clocks.



make them more economical . . . easier to use!

The improved CODE LINE of electrical products is meeting with instant approval the country over. On this page are illustrated a few representative stock CODE items, available for immediate delivery. We invite you to write us today for additional information. CODE stands for quality, and its many years of service has well equipped us with valuable "Know How" which means a safer, easier to install meter mounting. Write us today.

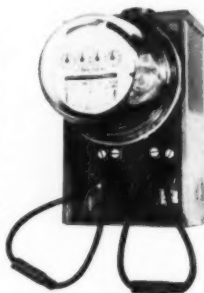


CODE Socket Meter Mountings

. . . do away with possible damage to Oil Heaters, Clocks and Other Electric Equipment, as well as annoyance. Additional mountings may be interlocked to this mounting while in service merely by removing the lid and the end wall.

CODE Socket Meter Mountings

. . . as illustrated, shows how simple it is for a meter tester to "by-pass" a meter when the meter is to be worked on or removed. Also note how open and accessible the terminals are to connect the "Line" and "Load" to, without removing any intricate parts of the mounting. A fifth and or sixth terminal may be added at any time.



"A" Type Meter Mounting

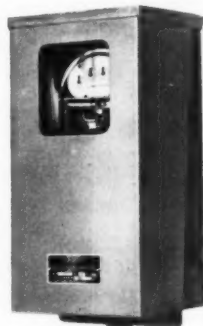
. . . Conventional General Electric Type where hairpin is moved to disconnect meter. Costs no more . . . and is easy for the contractor to install due to ample wiring room. Also easy to test meter.



CODE Total Enclosures for Bottom Connected Meters

. . . which means complete protection for the meter . . . a jeweled instrument. Designed so that practically any type four terminal standard meter may be installed. Comes complete. Less time and easier to install.

Absolute protection of meter mechanism against weather conditions. This cabinet also made for double and triple installations.



CODE Demand Meter Cabinet

. . . designed to house a demand meter and connection block. Note sloping side construction. Meter may be read through glass window. This cabinet is made also for double and triple installations.



We also manufacture a line of Indoor Meter Connection Boxes and Polyphase Meter Cabinets as well as many types of meter connection blocks.



THE CODE ELECTRIC PRODUCTS CORPORATION

214 KALOS ST., PHILADELPHIA 28, PA.

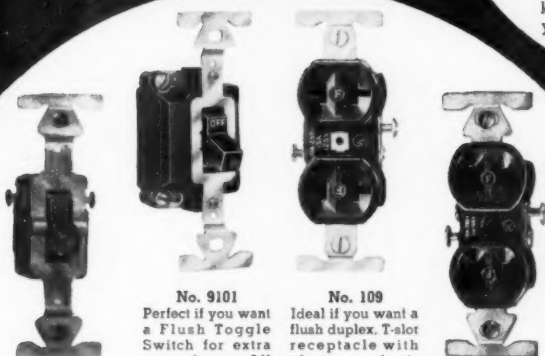
Follow the Circle..

You can trust it...


These Circle F wiring devices meet all federal specifications, and all requirements of the REA and CSA. They have earned approval of the Underwriters Laboratories.

You can sell it...

Circle F means wiring devices manufactured from the best grade of materials—by skilled labor—and thoroughly tested and inspected. You know you're selling the best when you sell Circle F.



No. 2035

If you want a small, compact switch that really stands up, get this all bakelite, Flush Toggle Switch with box screws mounted in ears. Single pole, brown or ivory. Easy to install. Wide ears scored. 5A-250V—10A-125V. 

No. 9101

Perfect if you want a Flush Toggle Switch for extra rugged use. All bakelite—totally enclosed—top wired—has positive kick off. Brown or ivory. Also in three way. 5A-250V—10A-125V. 

No. 109

Ideal if you want a flush duplex, T-slot receptacle with plaster ears that is quickly installed. Box screws mounted in ears. All bakelite body in brown or ivory. 10A-250V—15A-125V.

No. 136

You'll find this Duplex Flush Receptacle easier to install because box screws are mounted in ears—binding screws are backed out. Wide ears are scored. All bakelite—brown or ivory—double contacts. 10A-250V—15A-125V.

Write for our new Catalog
No. 18

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You can always count on...



Pick one of these and



AMERCLAD ... for abusive service

You can do just about anything to Amerclad Cables. They can be soaked in acid mine water, dragged over rock, reeled in and out, exposed to sunshine. Amerclad is made in sizes to fit anything from portable appliances to 45 cu. yd. power shovels.



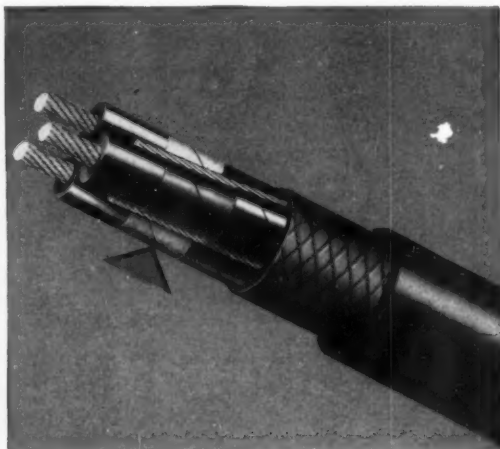
AMERBESTOS ... for the hot spots

When it's too hot for anything else, use Amerbestos. Our special "felted" construction enables the fibres to *stay put* even when the conductor is sharply bent. There's a full range of sizes to fit electric stoves or electric furnaces.



AMPYROL ... for replacement wiring

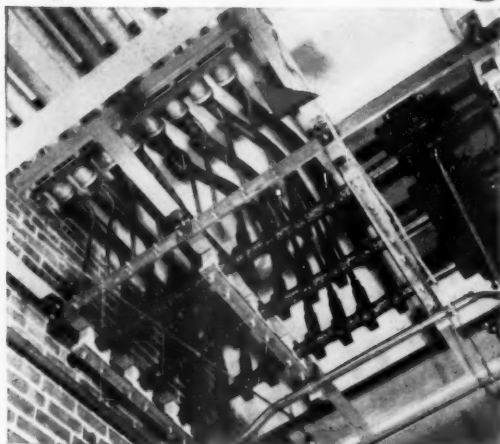
You can practically *double* the capacity of existing raceways when you rewire with Ampyrol. Six #12 Ampyrol wires can replace four #14 Type R wires. In addition, Ampyrol is easy to pull because it has a smooth, lubricated surface. For easy identification, the brilliant colors run clear through the insulation.



PS SHIELDING ... for safety

PS Shielding is a conducting rubber tape or compound, the original development of American Steel & Wire. It's available on all our high voltage cables to supplement or sometimes replace metallic shielding. Unlike metallic shielding, PS Shielding clings so tight that no gaps can form to cause corona discharge within the jacket. It's easy to splice and is not bulky.

you can't go wrong



VARNISHED CAMBRIC

... for heavy loads

Varnished cambric cables have an unexcelled combination of high dielectric strength, chemical stability (against oil and ozone) and long life at high temperatures. Also available in the form of AVC for extra heat resistance.



PAPER ... for high voltages

Paper insulated, oil impregnated and lead sheathed cables are rigorously checked with a high voltage time test, dielectric power loss test and power factor test. These cables are first choice for high voltage, trouble-free service.

Choose from hundreds of types and sizes of American Electrical Wire & Cable

We'll be pleased to give you more information on any of these quality wires and cables. Or, if you have a special problem, we'll be glad to give you a complete engineering analysis and discuss the many types of special purpose wires and cables not mentioned here. Just get in touch with your nearest American Steel & Wire office or write: American Steel & Wire Division, United States Steel Company, Rockefeller Building, Cleveland 13, Ohio.



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IN THE WEST—COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO • IN THE SOUTH—TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
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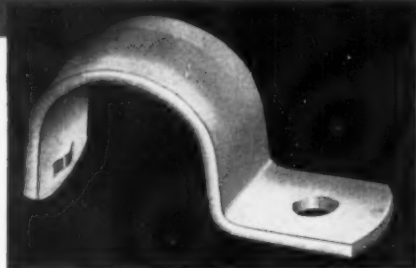
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UNITED STATES STEEL

PROMOTE REPEAT SALES BUILD GREATER PROFITS

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Blackhawk Industries
FITTINGS AND FIXTURES



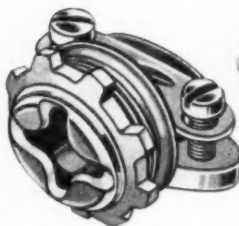
BLACKHAWK SNAP-STRAPS

"The strap with the built-in bump"

For rigid or thinwall conduit. Exclusive self-holding feature saves time on the job, eliminates fumbling and dropping, makes difficult installations easier. Made of heavy gauge steel, zinc plated after fabrication. Wide range of sizes for rigid and thinwall conduit. (Patent Pending.)

Blackhawk No. 470 Connectors

Made of special cast alloy. Strong, durable and non-rusting. Precision finished with full positive threads. Formed steel clamp and solid steel locknut with positive locking feature are heavily zinc plated. Full length filister head tapered point screws make installation quick and easy. No. 470 for "ABC" or flexible conduit. No. 425 for non-metallic cable.



Blackhawk No. 3626 Steel Clad Wire Holders

Made with heavy steel base and supporting strap. No. 22 square shoulder screw. All metal parts are hot dip galvanized. Porcelain has compression strain only. Smooth rounded surfaces protect wire insulation. REA approved.



Blackhawk No. 1426 Conduit Entrance Caps

Special high strength non-corrosive aluminum alloy. Easy and positive to position. Filister head cap holding screws. All threads are clean and full cut. For 2, 3, 4, or 5 wire service.



Blackhawk No. 711 Service Entrance Cable Heads

Features cast alloy body with separate cover. Heavy steel cable clamp. Large keyhole saves time, permits quick and easy attachment to building.



Blackhawk No. 514 Yard Lights

Highest quality porcelain enamel reflector, independently mounted. Zinc plated cast iron head and flange, galvanized conduit extension. Wired with porcelain socket and No. 14 TW wire.



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Entrance Cable Fittings • Staples • Yard Lights • Sill Plates • Locknuts and Bushings • Wire Holders • Cable and Conduit Straps • Fluorescent Brackets • Connectors • Box Supports • Conduit Entrance Caps • Grounding Assemblies.



steel clad

wiring systems

are essential to

AMERICA'S

DEFENSE

PROGRAM

The overall defense policy of the nation is pointed towards a continued emergency, requiring tremendous production of military equipment . . . new and enlarged defense installations . . . expanded building and maintenance of industrial plants to support this program. At best, the cost is . . . and will continue to be . . . staggering. We cannot let short-sighted planning, extravagance and waste cause our ultimate fall, as well they might.

It is wildly extravagant to attempt such a program on anything but a permanent basis!

Electricity is the nerve center of our defense effort. If defense installations are to be permanent, electrical distribution systems must be of the same quality.

Steel clad wiring systems afford *protection, security and permanence of installation which no other system can offer.* They provide:

- Protection against shock. Steel raceways are completely grounded systems.

- Protection from external mechanical damage to prevent time-consuming breakdowns.
- Protection against moisture.
- Protection against corona cutting and breakdowns on high voltage work.
- A pull-in, pull-out system for quicker electrical changes and repairs.
- Protection against fire hazards.
- Protection against tampering.

Specify steel clad wiring systems for all installations. No other electrical distribution system can match the security—the protection—the permanence of steel.

National Electric Products

PITTSBURGH, PA.

PLANTS IN AMBRIDGE, PA. • TORRANCE, CALIF. • ELIZABETH, N. J.

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Conduit Systems



SHERARDUCT—Full weight, threaded, rigid steel conduit fortified against rust and corrosion by the "Sherardizing" process of galvanizing, for lifetime protection. (also Xduct Electro-Galvanized and Economy Black Enamel Finishes)

Wired Systems



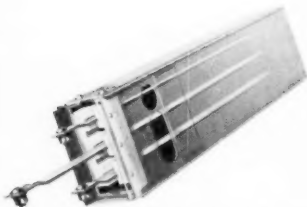
A.B.C. ARMORED BUSHED CABLE—Complete, ready-to-use electrical system. Conductors and raceway installed at the same time. Furnished with "Dilec Safecote" insulated wires.

Raceway Systems



XTENSIONDUCT—For extending circuits along walls and ceilings. Two-piece base and capping. No wire fishing necessary. Attach the base, lay-in the wires, snap on the capping.

Busway Systems



I.P.L. "PLUG-IN" BUSWAY—An enclosed busbar system for distributing electrical power 225 amperes up to 1500 amperes, 600 volts or less. Approved for mounting in horizontal or vertical position. 14 Plug-in openings, per 10' length, staggered on two sides, permit insertion of devices convenient to equipment.



XDUCT JUNIOR—Electrical Metallic Tubing. Steel, electro-galvanized, then further protected inside by a smooth, lustrous coating of clear, durable enamel on $\frac{1}{2}$ " and $\frac{3}{4}$ " sizes (black on other sizes).



FLEXSTEEL—Galvanized, flexible-steel conduit. Continuous runs from outlet to outlet reduce installation costs. Provides an economical "pull-in pull-out," electrical system.



NEPCODUCT—The steel underfloor raceway system that provides convenience outlets at the floor surface. For power, lighting, telephone and signal service in any type of floor construction.



"PLUG-IN" STRIP—Multi-outlet assemblies for residential or commercial use. Outlets every 18" or 6". Type CF-2 for "constant energized service." A modern, streamlined trim. Safe and strong.



TYPE CF2-G—with system grounding facility, for portable equipment, tools, etc. Permits use of grounded or ungrounded devices from the same outlet. Outlets every 18" or 6".



TYPE CF-3—provides wall-switch control for lamps, plus constant service for clocks, radios, appliances. Each receptacle—a choice of two services. Encourages "light ahead" residential wiring. Outlets every 18".



METAL MOLDING—For main lighting distribution and multiple branch circuits—also has the "lay-in" principle. Two-piece, base and capping with wire retainers.



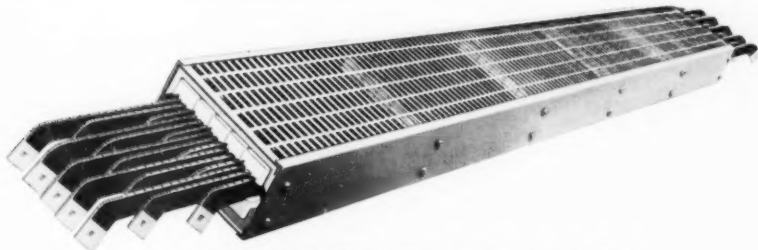
FLORDUCT—For across-the-floor service. Bump-proof, mop-proof, trip-proof—another NE raceway with the "lay-in" principle. Permits rigid mounting of base, positive capping action.



SURFACEDUCT—A 2-piece, all-purpose industrial "lay-in" raceway for every type of service up to 60 amp. Accommodates all manufacturers' approved devices.



4 x 4 WIREWAY—A hinged-lid steel wireway for feeders, branch circuits, control and signal wiring up to 600 volts. Speeds power rewiring. Eliminates exposed wiring hazards. Hanger type coupling permits flush mounting when necessary.

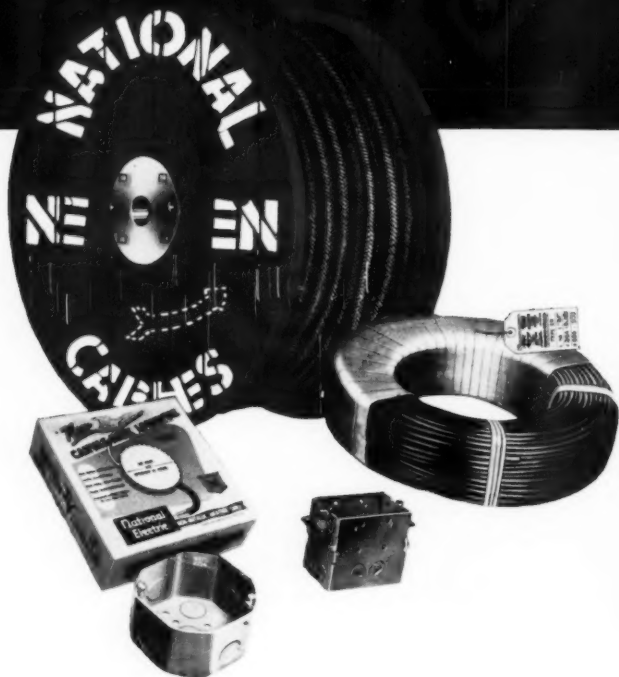


LO-LOSS FEEDER BUSWAY—Designed for transmission of electric current up to 4000 amperes at 600 volts or less. Insulated copper bars mounted on close centers provide low reactance—high efficiency. Ideal for welding and other low power factor loads and for riser application. Approved for vertical or horizontal mounting.

For All Systems

NE insulated building wires and cables with every type of insulation and covering, connectors, boxes and accessories to meet the requirements of any industrial, commercial or residential wiring job.

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Sold through leading electrical wholesalers.



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***Quality Control works
2 ways at CHESTER**

It's a fact and here's why! First, Chester quality control engineers certify every phase of manufacture from raw material to finished product packed for shipment. No detail is too small or unimportant to merit their full attention. Second, quality in turn governs production — not a single foot of Chester wire or cable is ever "hurried through" to meet a shipping date or heavy schedule. Extra shifts, not faster production is the method used to break bottlenecks at Chester.

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efficient fluorescent operation

long, trouble-free performance

full lamp life

rated light output

satisfactory overall lighting

...and there's a **NEW** reason for using

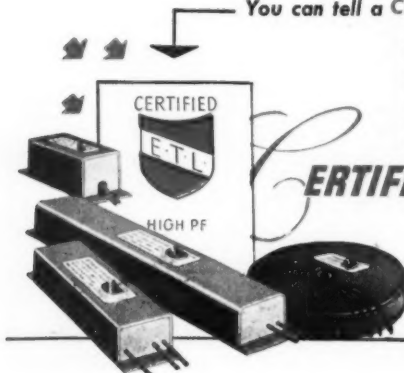
CERTIFIED BALLASTS

Conservation and efficient use of critical materials is now of vital importance to our national defense.

This adds a new reason for insisting on **CERTIFIED BALLASTS** in all fluorescent fixtures. For **CERTIFIED BALLASTS** always assure highest fluorescent efficiency and economy of operation.

CERTIFIED BALLASTS are tested by Electrical Testing Laboratories, Inc., which certifies they meet the precise specifications that assure efficient operation.

You can tell a **CERTIFIED BALLAST** by the shield.



• Complete information on the types of **CERTIFIED BALLASTS** available from each participating manufacturer may be obtained from Electrical Testing Laboratories, Inc., East End Avenue at 79th Street, New York, New York. Participation in the **CERTIFIED BALLAST** program is open to any manufacturer who complies with the requirements of **CERTIFIED BALLAST MANUFACTURERS**.

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CERTIFIED STARTERS reduce your fluorescent lighting costs in two ways:

1. They assure full life for the lamps.
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CERTIFIED STARTERS thus cut your maintenance costs as well as increase your overall lighting satisfaction.

CERTIFIED STARTERS do this because they are made to precise specifications drawn up to meet the particular starting requirements of the fluorescent tube. They are then tested by Electrical Testing Laboratories, Inc., which certified they meet these rigid manufacturing specifications.



For Better Fluorescent Performance
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Certified Fluorescent Starter Manufacturers

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ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . JULY, 1952

**EXPERTS AT WORK,
EXPERTS AT PLAY,
ALL AGREE:**

THERE'S ONE SAFE WAY!

It's the top of the ninth inning and the visiting team trails 4 to 1. After two are out, they get runners on second and third with a single and double. The cleanup batter is approaching the plate. He is the league's leading hitter, but is 0 for 3 for the afternoon. There are several things the home team manager can do, but one is really safe. Do you know which it is?



Baseball experts agree the thing to do is play it **safe** by putting percentages in your favor and pitching to the batter. Even if he clouts one, the score is only tied. But if you walk him, the potential *winning* run—a dangerous number five hitter—steps to the plate.

Electrical experts agree that you should play it safe when you have a problem in protecting lighting, power and distribution circuits. That means relying on circuit breakers for all-important protection.

The safest way to utilize the protection provided by circuit breakers is to start right at the service entrance. Service entrance equipment must provide overload and short circuit protection. I-T-E enclosed air circuit breakers are designed to give this protection. They operate on a common trip principle so that overcurrent on any pole will trip the breaker. A complete line of internally mounted breaker auxiliary devices can be supplied for any application. Installation is easy too, because I-T-E breakers are furnished with pressure wire connectors for front connection within the breaker frame.

Your decision on circuit protection is a safe one, if you specify I-T-E Molded Case Circuit Breakers. Every I-T-E breaker provides reserve protection because it has reserve thermal and mechanical capacity far beyond minimum requirements. Every I-T-E breaker will carry full rated load indefinitely.

You can get I-T-E *individually enclosed* Molded Case Circuit Breakers, designed and built by circuit breaker specialists, in four frame sizes covering:

10 to 600 amperes
up to 600 volts a-c
up to 250 volts d-c

All ratings are available
in four types of enclosures.

Type ET 600 ampere L frame
circuit breaker
2, 3 pole 250 volts a-c and
125/250 volts d-c
600 volts a-c and 250 volts d-c
125 to 600 amperes with inter-
changeable trip units.

To obtain a complete description of I-T-E Molded Case Circuit Breakers for all applications, consult your local dealer. Or write I-T-E Circuit Breaker Company, 19th and Hamilton Streets, Philadelphia 30, Pennsylvania. Ask for Bulletin 5108-D.



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TO PICK UP DUST OR
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STICK TOGETHER
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SPECIAL APPLICATION
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- CAN BE STORED
INDEFINITELY



Here is the multi-purpose electrical insulating tape for wire or cable splicing . . . the tape that meets your strictest requirements for many unusual as well as innumerable ordinary applications. BI-SEAL offers you complete and lasting protection against moisture, acids, alkalis, sunlight, corrosion, fungus and ozone. These outstanding characteristics, plus Bi-Seal's excellent electrical properties, make it ideally suited for a broad range of applications in the Communications, Electronics, Public Utilities, Electrical Contracting and Electrical Maintenance fields.

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trade-mark on box materials is your assurance that they are adaptable to all wiring needs . . . are handy to use . . . are recognized by architects, engineers, and builders everywhere . . . and are available nation-wide. Look for these two signs . . . insist on them!



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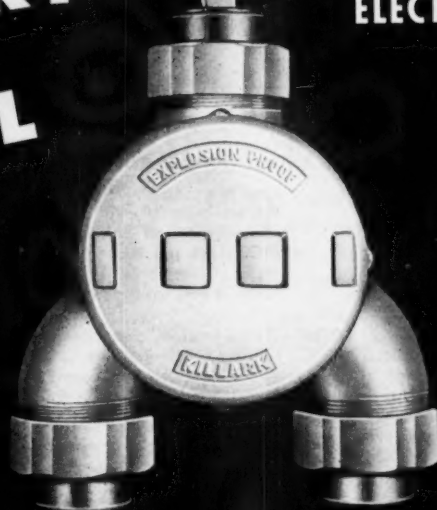
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Here are ruggedly-made iron conduit bodies that can be installed with the maximum of ease and a minimum of effort. EFCORLETS are newly engineered with accent on durability and trouble-free performance. EFCORLETS get that way, because they're made that way! Carefully made of high tensile strength iron, EFCORLETS are threaded so that the conduits will never shake loose.

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for:—Clean, carefully gauged threads • Maximum room for wire pulling and splicing • Rounded and bushed openings • Large radii to protect conductor insulation • Threaded straight to insure perfect conduit alignment • Interchangeable with almost all other round bodies.

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HOLGUN*
has 25%
more power!

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for TOP-SPEED DRILLING in TIGHT SPOTS!

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FOR A MODERN HOSPITAL

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MEANS WIRED FOR LIFE!

*Selection of Highest-Quality Wire and Cable
is still the Short Route to Customer Confidence!*

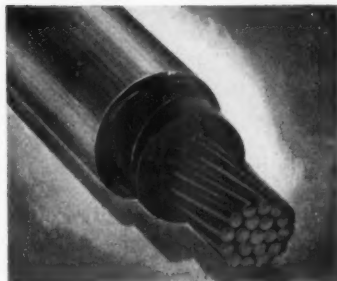
Specifying Habirshaw wire and cable, made by Phelps Dodge Copper Products Corporation, assures highest standards of electrical stability and dielectric strength. It's a *long step* toward complete owner satisfaction.

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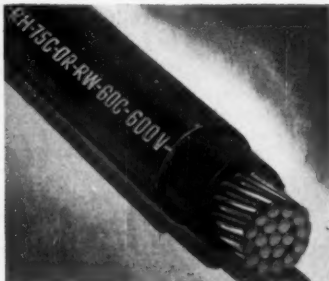
materials and workmanship . . . dependable electrical service for the life of the building.

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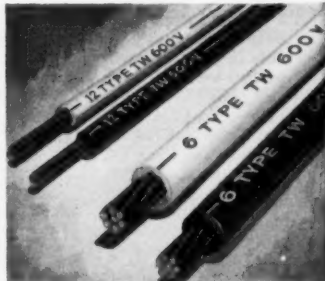
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● Primary—varnished cambric insulated lead sheathed cable for bringing power into the building.



● Heat-resistant, moisture-resistant, rubber-insulated, braid-covered cable for feeders to distribution points.

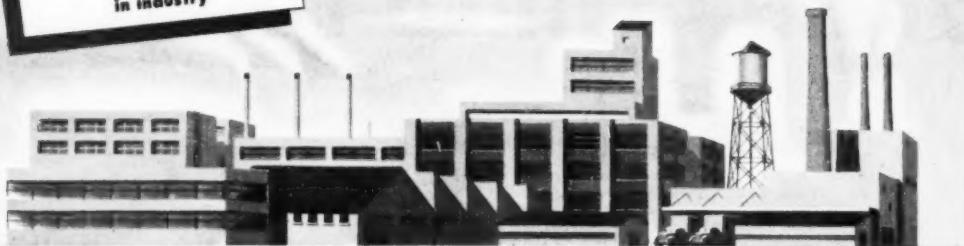


● Small-diameter, moisture-resistant Habirdure thermoplastic insulated wire for branch circuits.

PHELPS DODGE COPPER PRODUCTS **CORPORATION**

Manufacturers of the Famous "Habirshaw" Wire and Cable.

Wagner
TRANSFORMERS
... the choice of leaders
in industry



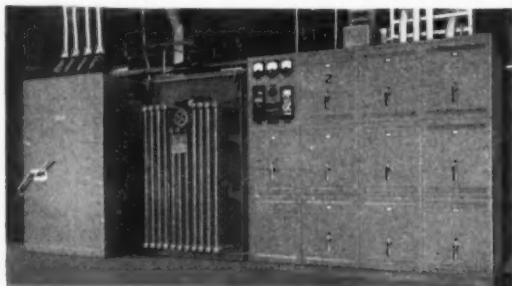
Wagner Dry-Type Transformers

...safe, efficient power distribution for your plant

Wagner Dry-Type Transformers are the answer to the problem of bringing the right voltage to load centers economically—yet with complete safety and dependability.

They can be used for a variety of purposes, such as insulating a lighting circuit from a power circuit, obtaining a 240/120 volt 3-wire circuit from a 2-wire system, operating low-voltage portable lamps, and supplying machine tool lighting from the power circuit. They are frequently used to step down power distributed at 480 or 600-volts to supply lights, portable tools and other 120-volt devices.

Wagner general-purpose dry-type transformers are available in single-phase, two coil units (Type AE) in sizes 1.0 to 200 kva, 600 volts and below; and in three-phase, two coil units (Type AP) in sizes 3.0 to 300 kva, 600 volts and below. Type AA Auto-transformers are also available. Write for a copy of Bulletin TU-90. It gives many suggestions that you can use.



Oil filled and non-inflammable liquid filled (Noflamol) transformers are available with various types of entrances and controls for high-voltage circuits, and with throats on the secondary side, in ratings up to 2000 kva.

Wagner
Electric Corporation
EST. 1891



UNIT SUBSTATION TRANSFORMERS

for dependable load-center power distribution

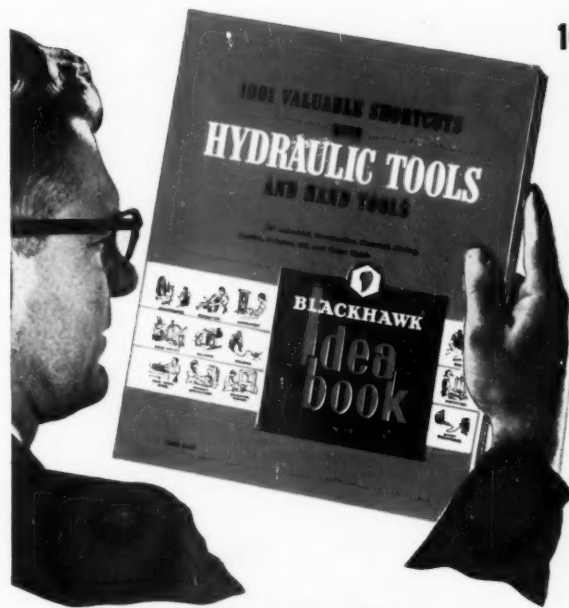
Wagner three-phase dry-type load-center transformers are built in ratings through 2000 kva in the 15-kv class and below. Transformer and incoming line section are housed in compact factory-matched enclosures, designed for direct connection to matching secondary switchgear to form a closely coupled unit substation that is streamlined in appearance and readily accessible. Complete enclosure of all equipment assures safety against contact with live parts.

Bulletins TU-56 and TU-13 give full information on Wagner Dry-Type and Liquid-Filled Substation Transformers. Write for your copies.

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**1001 shortcuts to save you time...
money...materials with
hydraulic tools and hand tools**

Here's the greatest collection of ideas ever compiled on new uses for hydraulic tools and hand tools. The IDEA BOOK gives you the benefit of ideas developed and applied by hundreds of users of Blackhawk equipment. Most important, the IDEA BOOK will stimulate you to create *your own* ideas . . . will show how Blackhawk equipment can solve special problems for you! So — *send for it!* You'll want to read every page — you may find a "gold mine" in any *one* picture.

You see, the same Blackhawk hydraulic tools you now use for bending pipe and driving knockout punches make many other jobs easier, faster, safer. With them, you can pull pulleys, move motors, install heavy equipment, handle many other allied jobs. Savings in time, money and materials are often spectacular.

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in big Idea Contest. Every 90 days Blackhawk will give generous cash awards and citations for the best original ideas using Blackhawk equipment. Get your IDEA BOOK today for complete details.

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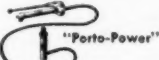
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and knockout punches



Specialized
hand tools

WHY DOES TRIANGLE GET SO MANY BIG JOBS?

When it's a big, important project, chances are that Triangle wire, cable and conduit are being specified. Electrical contractors for some of America's top industrial concerns, many of them vitally concerned in the defense effort, have used Triangle products.

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Dependability IS THE ANSWER

Triangle gets big jobs because people know **YOU CAN
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A TYPICAL EXAMPLE

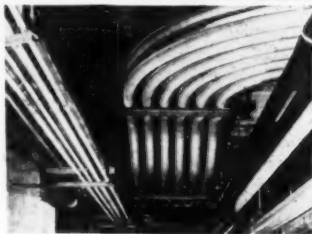
The World's Second Largest Airport

Electrical Engineer—James Paul Warner—Pittsburgh
Architect—Joseph Hoover—Pittsburgh
Electrical Contractor—Howard F. Ealey Co.—Pittsburgh



TRIANGLE Hot-Dip Galvanized Conduit

This conduit, placed in underground tunnels, carries feeder cables from powerhouse. Triangle conduit is hot-dip galvanized inside and out. It bends easily, resists flaking.



Just completed, the greater Pittsburgh Airport is a typical example of the major jobs Triangle has serviced. Over a million feet of Triangle conduit and cable were used. The airport, costing \$32 million, is exceeded in size only by Idlewild Airport, Long Island, New York.

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Need an entire new system? Or perhaps just one unit that meets present noise level needs? Buy UNIPACT. It's the best. UNIPACT is a tailor-made group of signals that are designed to master department noise levels with 17 interchangeable units—bells, buzzers, horns, chimes—all fitting one standard adapter plate. No new wiring is needed. Plant conversion is easier. Buy the proven brand—FARADAY.

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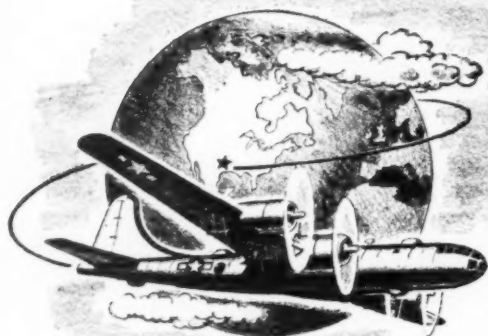
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Consolidated by:

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AND AUDIBLE PAGING DEVICES AND SYSTEMS



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1949 "LUCKY LADY", A USAF SUPER-
FORTRESS, FLEW FROM FT. WORTH,
TEXAS, 23,452 MILES AROUND THE
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Gold Seal Tape
GOES FURTHER, TOO...



GUARANTEED FOOTAGE

You get full measure with every roll. Tapes up tight and snug to the last inch.

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All Gold Seal Friction Tape tears evenly, does not ravel, molds to uneven surfaces.

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Less Gold Seal Tape needed per job. No pinholes; one tape thickness insulates.

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Gold Seal sticks to the job under toughest conditions of cold and moisture.

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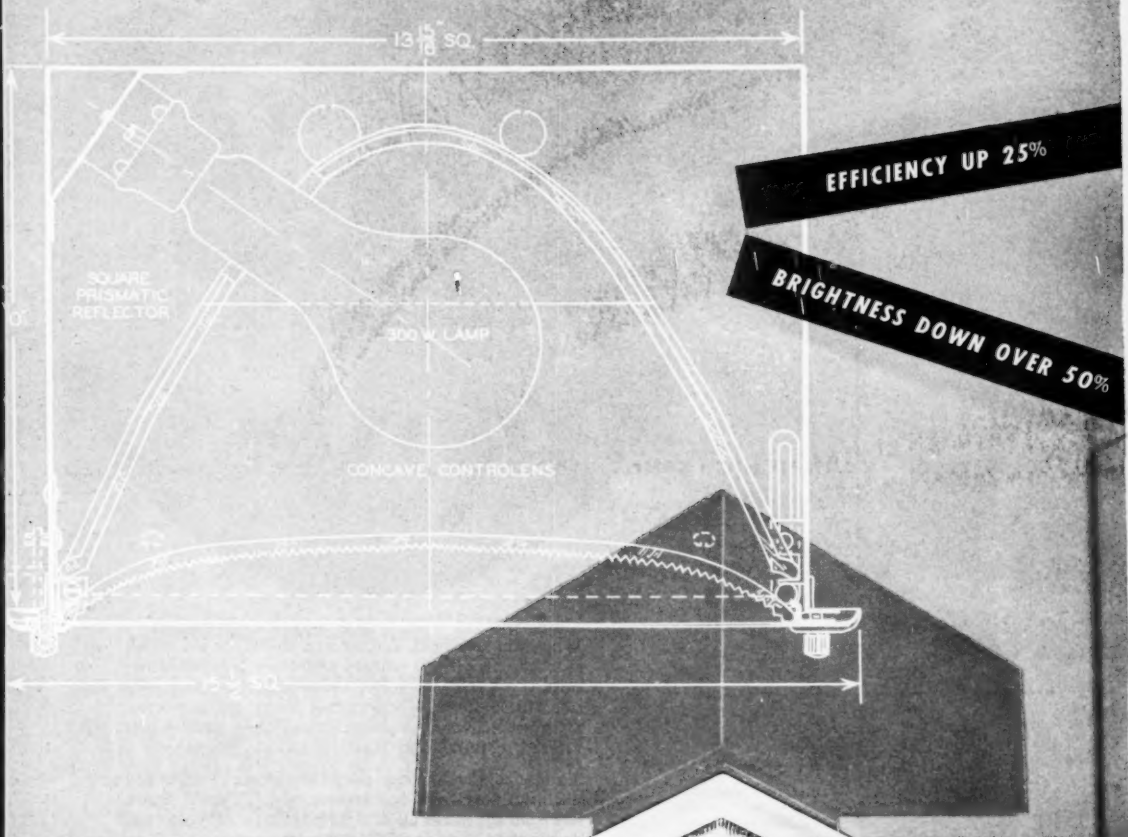
In either 10-roll cartons or single rolls. Every roll sealed in cellophane, stays fresh. Jenkins Bros., (Rubber Division), 100 Park Ave., New York 17.

Jenkins Bros. also make Diamond Seal Friction and Rubber Tapes which meet ASTM and Federal Specifications.



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HOLOPHANE In-Bilt
Unit with LO-BRITE*
Concave CONTROLENS***

- HIGHER EFFICIENCY... Stepped up 25%
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- LARGER LENS and NARROWER TRIM provide the ideal proportion for distinctive design

Architects and engineers are invited to write for complete data. No obligation of course.

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CLASSROOMS
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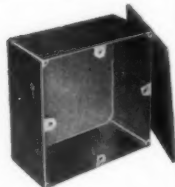
HOLOPHANE COMPANY, Inc.

Lighting Authorities Since 1898 • 342 MADISON AVENUE, NEW YORK 17, N.Y.
THE HOLOPHANE COMPANY, LTD., THE QUEENSWAY, TORONTO 14, ONTARIO

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O. Z. cast iron boxes

COMPLETE LINE • COMPLETE LINE • COMPLETE LINE • COMPLETE LINE



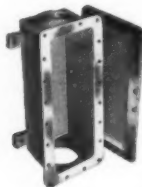
TYPE YS

Unflanged junction box with cover. Flush or Surface mounting.



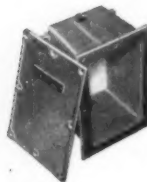
TYPE YW

Weatherproof pull box. Complete with one-piece rubber gasket and hinged cover; surface mounting.



TYPE YE

Explosive resisting junction box designed in accordance with Underwriter's Laboratory requirements. Cover and flange are accurately machined and correct bolt spacing provided. Flush or Surface mounting.



TYPE YF

Flanged watertight box with cover complete with rubber gasket. Flush or Surface mounting.

When you specify O. Z. Cast Iron Boxes for industrial, railroad, airport, oil refinery and other heavy-load circuits, you specify the best. Cast from close-grained, grey iron, these sturdily constructed boxes are accurately machined to your requirements and then hot-dip galvanized to provide maximum corrosion resistance.

No matter what the operating condition . . . explosion resisting, watertight or weatherproof . . . you'll find a box to fit the job in O. Z.'s complete line. All boxes can be supplied with or without bosses or mounting lugs and are drilled for conduit entrances as required.

For detailed information on O. Z.'s Cast Iron Boxes as well as 150 other electrical fittings, write for our catalog.

- CAST IRON BOXES
- SOLDERLESS CONNECTORS
- CONDUIT FITTINGS
- CABLE TERMINATORS
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- POWER CONNECTORS



Buy O. Z. and you'll see why Engineers say,

"They're OK If They're O. Z."

**O. Z. ELECTRICAL
MANUFACTURING
COMPANY, INC.**
262 BOND STREET • BROOKLYN 2, N. Y.



PICK 'EM OUT PLUG 'EM IN

1 Select Multi-Breaker units required by job.

2 Assemble units to panel by "plugging in".

Make up the Cutler-Hammer Type NMO MULTI-BREAKER "Plug-In"

BREAKER PANELS

TRADE MARK

on the job - for the job

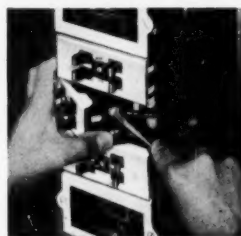
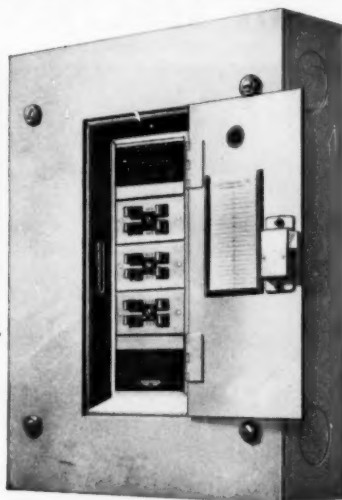
No matter what the job calls for when you get there, you are all set when you have a Cutler-Hammer Type NMO Breakerpanel. No matter what circuit load changes may be required if you are called back later on, you are ready if you have installed a Cutler-Hammer Type NMO Breakerpanel. For you make up these distribution centers with the Multi-Breaker Plug-Ins right on the job for the job. No guesswork. No mistakes. The Multi-Breaker units you select to serve your circuits just plug into place. Where you want a 15 ampere breaker, you plug in a unit containing the exact number of 15 ampere single pole breakers required up to four. These units are available in... different circuit combinations making it possible to obtain the exact quantity and rating of branch circuits with a minimum of effort.

Cutler-Hammer Type NMO "Plug-In" Breakerpanels are now offered in sizes with from 8 to 42 single pole branch circuits in increments of 2. They are available in 120/240 Volts a.c., with 50, 100 and 200 ampere mains (lugs or circuit breaker) with 15, 20 and 30 ampere single and double-pole branch cir-

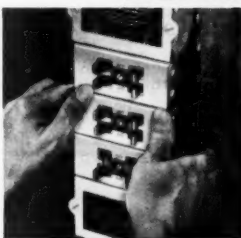
cuits; also, 40 and 50 ampere double-pole branch circuits. Multi-Breaker units are of the thermal-magnetic type that provide a lag on harmless overloads but instant trip on shorts.

Wiring these Type NMO Multi-Breaker units is also a cinch. You can wire them right in your hands before you plug them in... or you can simply swing them out for wiring as shown, using one of the positive-pressure contact jaws turning on the silvered bus bar as a hinge. And despite the small size of these Breakerpanels that better utilize wall and column space, you get much more gutter space ($5\frac{1}{4}$ " in the 15" box) with more circuits. The narrow column type actually has double the number of circuits previously available in cabinets of similar height.

Beyond any doubt, this is the finest protection, the easiest to install, the most flexible, the most compact, and the most modern it is possible to obtain where a large number of branch circuits must be served, as in commercial and industrial buildings, hotels, schools, hospitals, large homes, etc. CUTLER-HAMMER, Inc., 1306 St. Paul Avenue, Milwaukee 1, Wisconsin.



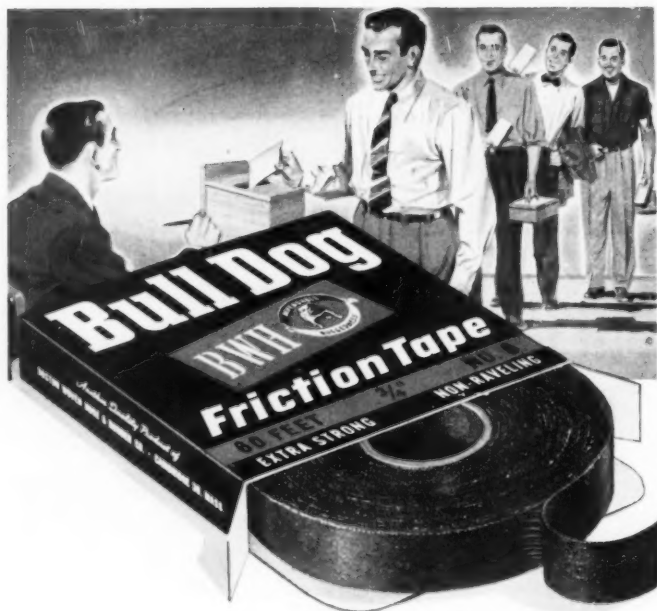
3 Wire them.



4 Plug them in place again.



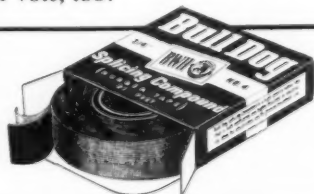
BULL DOG FRICTION TAPE WINS THE ELECTRICIAN VOTE!



FIRST at the polls with electrical men is the tape they swear by, not at . . . BULL DOG Friction Tape.

- That's because BULL DOG grabs fast, holds tight . . .
- Never ravel or frays . . .
- Resists wrinkling . . .
- Stays fresh in the roll and on the job.
- You try it . . . it'll get your vote, too!

P. S. While you're at it, stock up on BULL DOG Splicing Compound. Tops for high resistance to electricity and water . . . and it is self-vulcanizing into a solid, watertight joint.



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Electrical Specifications

Wiring Plans

The steps to follow in preparing the wiring plans are:

Initial space provisions: Obtain tentative location and type of service, especially if current is to be supplied by the power company, based on the approximate demand for the building. Assign liberal spaces and clearances to accommodate service raceways, service equipment, transformer stations, and main distribution center. Final details can be determined only after the layout is completed and the load has been computed.

Lighting layouts: Locate and mark by standard symbol all (1) lighting outlets, (2) convenience, appliance, heavy-duty or other special outlets, local or multilocation switch controls (show outlets they control), (3) special lighting equipment built in to architectural features of the space, (4) outlets or in-built lighting equipment in fixtures, furnishings or machines, lighting panelboards. Determine circuit distribution, interconnect outlets, and assign circuit numbers. Where the wire is larger than No. 12, show the size, the number of wires per run, and the size of raceway to be used. Underfloor systems are preferably shown on separate plans. Manufacturers can provide typical floor plans. Extensive fluorescent lighting systems of close spaced troffers, luminous ceilings and similar installations should also be shown on separate plans which also show other mechanical and electrical features which must be considered in the installation. (Sprinkler heads, air conditioning, outlets, etc.)

Power layouts: Locate and mark by standard symbol all (1) motors, (2) controllers, (3) stationary heating devices, (4) remote control and auxiliary control devices, (5) power panelboards. Determine branch circuit distribution, wire and raceway size, and assign circuit numbers.

Where any considerable number of motors is to be wired for, the location of each motor and other power equipment, such as heaters, should be shown on the plans, also showing the hp or kw rating, the kind of machine driven and the location of the controller. It is well to assign a number to each motor and to prepare speci-

More Specifications on Page 232



New GarCY Lighting Catalog

now ready!

Write for your copy



GARCY "Thin Panel" LUMINAIRES WITH METAL SIDES

2 lamp or 4 lamp; 4 ft. or 8 ft.; fluorescent or slimline; closed or open top; Spot-a-Lite units to match.



GARCY "Thin Panel" LUMINAIRES DIFFUSING SIDE PANELS

2 lamp or 4 lamp; 4 ft. or 8 ft.; fluorescent or slimline; closed or open top.



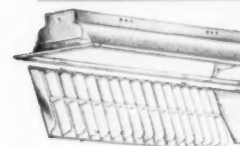
5082M Series LUMINAIRES WITH METAL SIDES

2 lamp or 4 lamp; 4 ft. or 8 ft.; fluorescent or slimline; closed or open top; Spot-a-Lite units to match.



5082P Series LUMINAIRES DIFFUSING SIDE PANELS

2 lamp or 4 lamp; 4 ft. or 8 ft.; fluorescent or slimline; closed or open top; Spot-a-Lite units to match.

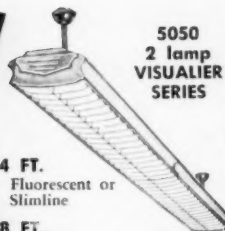


5500 Series TROFFERS

1, 2 or 3 lamp rows; louver, lens, diffusing glass or open bottom; 4, 6 or 8 ft. lengths; fluorescent or slimline — also Spot-a-Lites to match.



9674 Series combines FLUORESCENT and INCANDESCENT light



5050 2 lamp VISUALISER SERIES

4 FT.
Fluorescent or
Slimline
8 FT.
Slimline



5054 4 lamp VISUALISER SERIES

4 FT.
Fluorescent or
Slimline
8 FT.
Slimline

Designed to save you
TIME-LABOR-COST!

NEW GARCY ADJUSTABLE stem hangers



Easy Hook-on Attachment

Stem hooks on to hickey. No nuts or bolts. Stems are attached to fixtures hanging down on the floor before hanging.



Canopy covers standard ceiling fans, whether mounted recessed or surface mounted.

Easily Adjusted

A few turns of the stem lengthen or shorten it to compensate for uneven ceiling conditions.



New hanger bulletin sent on request

GARDEN CITY PLATING & MANUFACTURING CO.

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No. 16772-L



INCANDESCENT UNITS Wide Variety Available

6970 series



GARCY Adda-Strip

A complete line for every strip lighting application. Lengths from 18" to 96" for practically every fluorescent or slimline lamp. Also easy-to-attach reflector strips for directional light control.

**BUY TODAY • HEAT TOMORROW
WITH
ELECTROMODE**

*Cut
Plant
Heating
Costs*



**FOR THOSE
HARD-TO-HEAT
AREAS**

Model 14-10 Suspension Type 10,000
watts. 230/240 volts.

Do you have a heating problem in your plant or office . . . any hard-to-heat area? Electromode heaters are your logical answer.

Here's why . . . Electromode heaters are available in all sizes and capacities from 1500 to 45,000 watts to fit any heating problem. They can be located anywhere that electrical wiring can be strung. Equipped with automatic temperature controls and built-in safety switch, means economy of operation and absolute safety from fire, shock, or burn. The exclusive patented cast-aluminum heating elements will not rust or corrode. Electromodes provide an abundance of fan-circulated heat when and where it is needed. Approved by Underwriters' Laboratories and thousands of commercial and industrial plants throughout the country.

► **EXPLOSION-PROOF HEATERS** for HAZARDOUS LOCATIONS

The only Electric Explosion-Proof Heater of its kind approved by Underwriters' Laboratories. Features Electromode patented cast-aluminum heating element. Specially designed for installation in hazardous areas where heat is required and danger of explosion exists. Available in 2000, 4000, 6000 watt capacities. For full particulars mail coupon below.



Model CX-2 Convection Type 2000 watts 240/480 volts.

**ELECTROMODE HEATERS
ARE USED IN THESE
HARD-TO-HEAT AREAS**

- Factories
- Offices
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- Pump Houses
- Water Houses
- Watchman Houses
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- Factory Offices
- Lobbies
- Storage Rooms
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- Garages
- ... and hundreds
of other locations.

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complete Electromode Heater information.

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☐ Electromode Office Heaters
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NAME _____

TITLE _____

ADDRESS _____

Electrical Specifications

ification sheets giving for each motor or heater its number, location, hp or kw rating, description of machine driven type of controller to be used and auxiliary control equipment.

Auxiliary system layouts: Locate and mark by standard symbol, all (1) auxiliary system outlets, such as telephones, gongs, annunciators, etc., (2) junction or terminal cabinets, (3) batteries, transformers, or other power supply sources. Determine circuit routing, indicate on plans and riser diagram, and provide for panelboard circuits to supply auxiliary systems.

Circuits

Circuit runs: For concealed work in fireproof construction, circuit runs should as far as possible be shown as straight lines from outlet to outlet. For concealed raceway work in wood joist construction, right angle bends must as a rule be used and it is preferable to lay out the work in such manner as to indicate such bends on the wiring plan. For exposed work the approximate actual position of the runs should be shown.

Abusive or hazardous area design: Isolate or place in a separate room wherever possible all equipment the safe or successful operation of which would be affected by (1) abrasive metals, dust and chips, (2) condensation, (3) corrosive atmospheres, (4) excessive temperatures, (5) grease and oil, (6) excessive vibration, (7) water drippage or splashing, (8) explosive dusts or fumes, (9) ignitable fibres, flying or accumulations, (10) flood water. Provide sealing fittings in raceways leading to rooms of widely different temperatures, to prevent air circulation within such raceways.

Final calculations: Calculate, route and indicate on plans and riser diagram the complete feeder system, main distribution equipment, and service equipment.

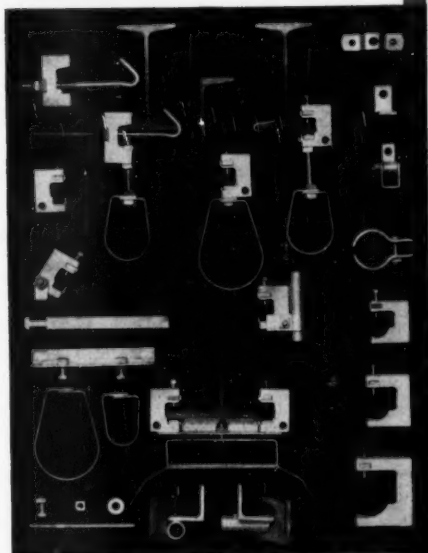
Tracing methods: In addition to using standard wiring symbols, the wiring plan tracings will be more easily checked in the office during the progress of design during construction, or in case of revisions, by employing various colors of tracing ink to distinguish between lighting, power, signal, telephone, fire alarm or special systems.

More Specifications on Page 234

Solve *Your* Problems

in

*Hanging and
Supporting
Pipe, Conduit
or Tubing
with . . .*



Steel City-Kindorf Devices

With these devices you can do the best possible job — from the simplest to the most complex — at a saving of high-cost installation time . . .



In conduit hangers and supports, as well as in electrical boxes and conduit fittings . . .

The products shown above have been especially designed for single runs of conduit and are stocked by leading wholesalers.

These clamps and hangers will provide you — at the lowest cost — the most satisfactory installations.

In case of installations involving multiple-runs of conduit, such as illustrated at the left, write for our well-illustrated and descriptive catalog, K-11, or for the address of our representative nearest you.

STEEL CITY LEADS
In Meeting Contractors' Needs

STEEL CITY

OUTLET BOXES AND COVERS
JUNCTION BOXES, CONDUIT FITTINGS AND KINDORF DEVICES



ELECTRIC CO.

SWITCH AND FLOOR BOXES
PITTSBURGH 33, PA.

AUSTIN Top Quality, Low Cost, Easily Installed, PORTABLE LIGHTING UNITS

Meets the demand for more adequate light. For all outdoor spot and floodlighting jobs — quickly, easily and economically installed. Completely packaged for your convenience.



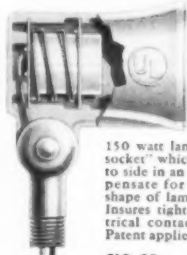
LS-5
150 watt lampholder mounted on sturdy metal spike for nailing to side of building, post or tree, or inserting in ground. Complete with 5' cord and plug.

LS-10
Same as above, with 10' cord and plug.



LC-2
150 watt bracket type lampholder complete with combination cover for mounting on 3/4" or 4" octagon box, post or wall. Includes 20' of portable cord with stripped and tinned leads. Cover has knockouts to fit box ear centers and to allow cord to enter box.

LC-5
Same as above, with 5' cord and plug.



**CLD-150
LAMPHOLDER**

150 watt lampholder with "floating socket" which moves forward or side to side in an eccentric plane to compensate for variations in size and shape of lamps, sockets or castings. Insures tight seal and positive electrical contact. Completely wired. Patent applied for.

CLD-35
Same as above for 300 and 500 watt mogul base lamps.



CPB-150
CLD-150 "floating socket" lampholder mounted on PB-1/2 wall or pole bracket having 2 porcelain insulating tubes to protect leads.



CLD-sp-150
CLD-150 "floating socket" lampholder mounted on sturdy metal spike, with 10' cord and plug.

CLD-sp-35
Same as above, with CLD-35 "floating socket" lampholder for 300 and 500 watt mogul base lamps.



COMBINATION UNIT

CLD-150 "floating socket" lampholder mounted on a CO-1 cover with 1/2" threaded hub, in center. Cover fits 3/4" round ceiling pans, 3/4" and 4" octagon boxes and concrete boxes. Provided with knockouts to fit box ear centers and to allow cord to enter box.

The M. B. Austin Company
NORTHBROOK, ILLINOIS

Write for Information and Prices

Electrical Specifications

To prepare complete wiring layouts, various standards, recommendations, or engineering data, are needed for determining loads, number of outlets, controls, or routing of circuits.

The data tables in section H.1.1 will provide much of the basic information necessary.

Lighting outlets: In many cases, particularly in industrial plants, either the various classes of work to be done have not been assigned to definite spaces in the building when the wiring layout is made, or there is a probability that at some future time machines and other equipment will be relocated. In all such cases, wiring capacity should be provided that will be sufficient for the maximum probable need.

Layout

The first step in laying out a wiring system is to determine the outlet locations and loads.

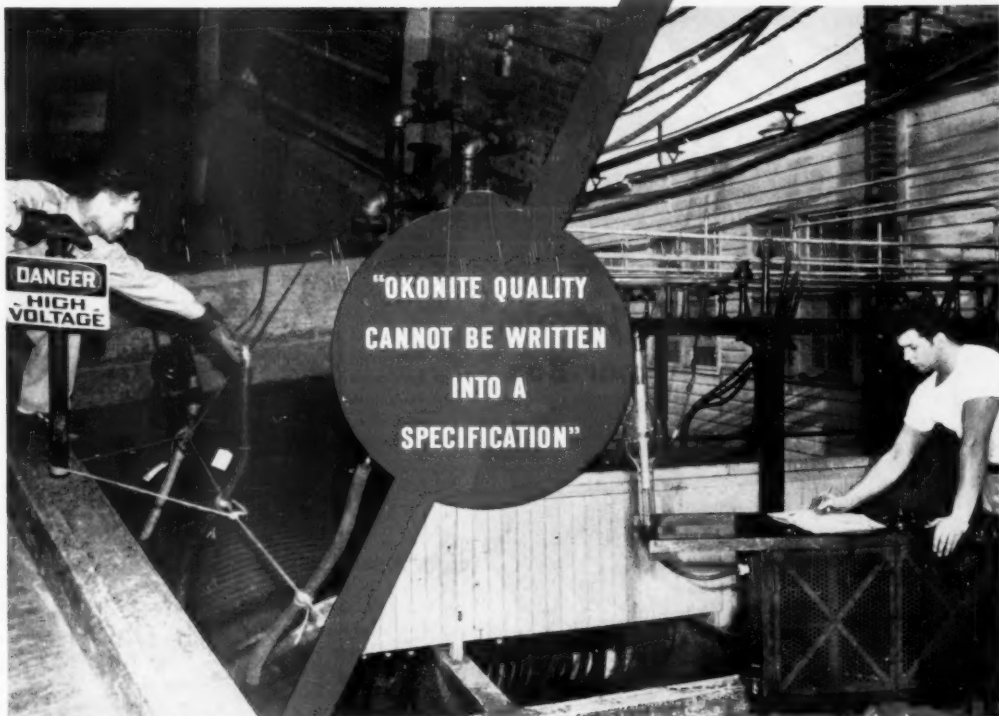
As the architectural features of the room or space become more important, the choice in the location of outlets becomes more and more restricted. Extreme cases are churches, theatres and similar buildings of somewhat elaborate architectural treatment, where the lighting equipment, whether concealed or exposed, must be located so as to fit properly in its surroundings. Similar conditions may be met in some retail stores, hotel and office building lobbies, lodge halls, libraries, banking rooms, etc. At least a preliminary design of the lighting system should be made in these cases before the wiring is laid out.

Any space that is to be occupied as an office in an industrial building is to be treated as an office, while a workshop in a commercial building is to be treated as industrial.

Incandescent lighting loads: To determine the wattage loads after the outlets have been located, take the watts per square foot required, for the given case multiply this figure by the total area of the space, in square feet, to find total watts. This result divided by the total number of outlets gives the computed watts per outlet.

Example: A retail store sales room

More Specifications on Page 236



"OKONITE QUALITY
CANNOT BE WRITTEN
INTO A
SPECIFICATION"

Specify Okonite by name

Electrical specifications should be written to cover your particular needs, plus an adequate margin of safety. In the case of electrical wires and cables for critical circuits—circuits which *must not* fail—you can be assured of Okonite quality only by specifying Okonite by name.

Okonite quality—that *extra margin* of circuit dependability—cannot be written into a specification. That's because Okonite quality is represented not by any one material or manufacturing technique, but by a vast background of accumulated research, proof-testing and on-the-job experience.

Take Okolite-Okoprene cable, for instance.

Together, the basic Okolite insulation and the Okoprene sheath are the result of an intensive research program and service experience extending

back approximately twenty-five years.

Insulation and sheath of Okolite-Okoprene cables are applied by Okonite's exclusive strip process, a cable-making technique used by no other manufacturer in regular production. Only with this process can uniformity and stability be assured.

Ultra-high voltage testing, the highest in the industry, safeguards Okolite-Okoprene against even the slightest imperfections. And of course Okonite's on-the-job performance record has been documented by utilities and industrial plants throughout the country, time and again.

All these "plus" values are obtainable only in Okonite cable. That's why so many cable buyers today make it a point to specify Okonite by name. The Okonite Company, Passaic, N. J.



The best cable is your best policy

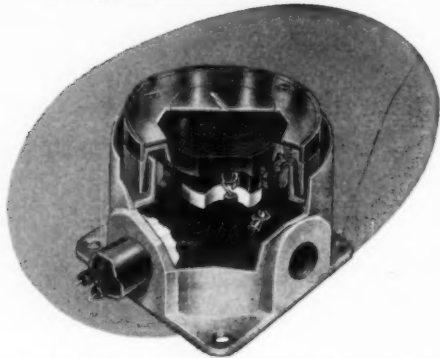
OKONITE



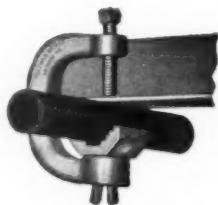
insulated wires and cables



The Improved "Latrobe" Adjustable Floor Box



Now equipped with an insulated 14-strand copper wire which provides a positive electrical bond between exposed flush parts and conduit system, conforming to Underwriters' Laboratories specifications. One terminal comes attached to bottom of box, and the other may be readily attached to cover. Once installed, wire cannot come in contact with exposed receptacle terminal screws inside box. Completely fireproof. Complies with National Electrical Code.



No. 471 "Latrobe"
Pipe or Conduit Hanger

Economical—for hanging pipe or conduit to steel beams. Eliminates drilling and straps. Takes 1/2", 3/4" and 1" pipe.



No. 252-R Two Gang
Adjustable Floor Box

Neat and practical. No. 208 receptacle in one section. One cover plate has 1/2" flush brass plug; other has 2" plug. Also equipped with ground wire.

Sold Only Thru Wholesalers

FULLMAN MANUFACTURING CO.
LATROBE . . . PENNSYLVANIA

Electrical Specifications

measures 45 ft. by 96 ft. and there are 18 ceiling outlets. Single-lamp fixtures are to be installed. What is the proper wattage per outlet? The standard load is 4 watts per sq. ft.

45 by 96 = 4320 sq. ft. total area
4,320 by 4 watts = 17,280 watts

$\frac{17,280}{18} = 960$ watts per outlet

This wattage should then be adjusted to 1000, this being the nearest commercial lamp rating.

In those cases where an illumination system has been designed and specified to produce values of illumination intensity lower than the maximum values referred to above, the wiring layout nevertheless should be based upon the standard lighting load tables.

If no occupancy corresponding to the given case is listed in the tables, a preliminary illumination design will determine the watts per outlet.

Fluorescent Lighting

Fluorescent lighting loads: To determine loads required for fluorescent lighting an illumination design must be prepared for typical areas and the watts per square foot determined for each type of lighting application. For instance a school project would require a class room layout, auditorium layout, corridor layouts, etc. In each case the watts per square foot required would then be applied to all similar areas in the building.

Convenience outlets: In retail stores the use for which convenience outlets are intended should be carefully considered. The general recommendation is not over six outlets per circuit but in many cases this number should be reduced. Only one outlet per circuit may be desirable in certain cases.

Outlets for show window lighting should usually be located on the sides of the columns, at or near the height at which the lighting equipment is to be located.

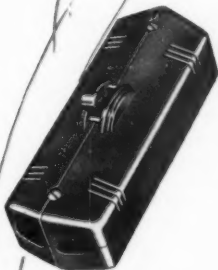
Floor outlets for show case lighting should be located from final plans showing the exact locations of the store fixtures. In a small store having an unfinished basement, circuits may be carried down from the cabinet to a junction box in the basement. These circuits may be run to the desired locations after the fixture locations have been determined.

More Specifications on Page 238

NEW IDEAS in specification grade devices to save you time on wiring jobs!

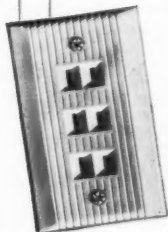
MONOWATT SURF-A-LINE WITH UREA BASES

Arc-resisting urea bases and high insulation barriers between current-carrying parts make these surface wiring devices better than ever . . . even under most severe conditions. Because Surf-A-Line combines box, device and cover into one unit, up to 50% installation time is saved at each outlet. For use with building wire, non-metallic and armored cable.



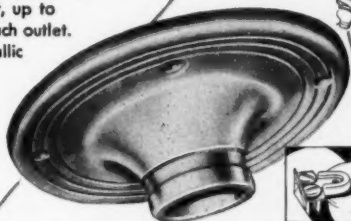
MONOWATT COMBINATION DEVICES—

are pre-assembled as complete units. Easier, faster to wire . . . cost less than separate devices of equal quality. Just two screws mount complete unit. Flush mounting is automatic . . . no adjustments needed. Modern triple outlet (illus.) gives extra convenience of added outlet. Other combinations of outlets, single pole switches, 3-way switches, pilot lights available.



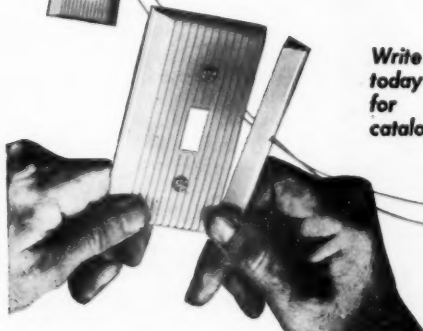
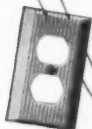
MONOWATT CEILING LAMPHOLDER

designed for speed in wiring, plus dependability. No internal mechanism to insert, no porcelain ring to work loose or crack. Double terminal screws for continuous wiring . . . eliminate soldering and taping. Units fit both 3 1/4" and 4" outlet boxes.

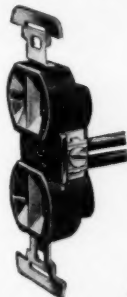


MONOWATT BREAK-OFF

WALL PLATES — keep jobs moving. Plates can be used alone or ganged on the job to any combination. No stoppages for a special plate for a special purpose. Screws held in place with fiber washers for quick mounting.



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today
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MONOWATT BACK-WIRED OUTLET. New wire clamp on this sturdily built double outlet simplifies wiring . . . eliminates working with binding screws in cramped space. Just strip about 3/8 inches of insulation off the conductor ends, slip them under the wire clamp and screw clamp down. Looping and twisting conductors around binding screws is eliminated, saving time and wire at each outlet.



A DEPARTMENT OF GENERAL ELECTRIC COMPANY, PROVIDENCE 7, R. I.

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . JULY, 1952

237

HEVI DUTY TRANSFORMERS

for power distribution and lighting

These Hevi Duty dry type transformers are installed in the new casting cleaning plant of the Bucyrus-Erie Company of South Milwaukee, Wisconsin. They are designed and built to provide many years of dependable service under adverse conditions.

*For more information about Hevi Duty dry type transformers write for
Bulletin HD-499.*

HEVI DUTY ELECTRIC COMPANY

HEAT TREATING FURNACES **HEVI DUTY** ELECTRIC EXCLUSIVELY
DRY TYPE TRANSFORMERS — CONSTANT CURRENT REGULATORS
MILWAUKEE 1, WISCONSIN

Electrical Specifications

Outlets for wall case lighting can usually be located in the wall so as to be just above the cases. Wiring can then be extended on the tops of the cases to the lighting equipment. Where display cases back of the counters and on the column lines are to be lighted, outlets may be located on the column just above the cases, or if this is not feasible, floor outlets must be provided.

Lighting branch circuits: Having determined the outlet location and the watts per outlet, or outlets per circuit, the number of branch circuits should next be determined. It is preferable to make a final check by laying out the circuits on the floor plans. The number of circuits for general illumination is determined from the outlet wattage, and the usual limit is 1000 watts per circuit for 15 ampere circuits. For loads operating continuously over long periods of time, (school lighting, industrial general lighting etc.) the current should not exceed 70% of the circuit capacity and must not exceed 80%.

For example, for continuous operation the incandescent lamp load on a 20 ampere circuit should not exceed 1680 watts (at 120 volts) or 14 amperes. For fluorescent lighting the rated lamp wattage does not provide an exact measure of the current which includes ballast losses. For high power factor ballasts a widely used design factor is 1.25 times the lamp wattage (thus 2 - 40 watt fluorescent lamps would equal 100 watts for circuit and load purposes).

Heavy Duty Circuits

Heavy-duty branch circuits: Where the entire load on a circuit consists of mogul-base lamps or mercury-vapor lamps, special high capacity circuits may be used. These are known as "heavy-duty circuits." These circuits may consist of No. 12, No. 10, or No. 6 wire, with overcurrent protective devices rated or set at 20 amp, 30 amp, or 50 amp, respectively.

For mogul-base incandescent lamps, these high capacity circuits should be so laid out that the initial load may be increased by substituting lamps of the next larger size. Circuits of No. 12 wire need not be considered because with this size the voltage drop

More Specifications on Page 240

Easier to Maintain!

EVERY PART REMOVABLE FROM FRONT in NEW CLARK type "CY" AC STARTERS

Besides featuring an entirely new principle of arc interruption which substantially lengthens contact life, CLARK Type "CY" AC MOTOR STARTERS provide faster and easier inspection and maintenance by a new design which permits removal of every part from the front. No special tools are required.

Figure 1 shows the clean-cut open construction with easy access to wiring terminals and all components.

- 1 To inspect movable contacts, simply push down contact bars to depress springs "I".
- 2 To inspect stationary contacts, open snap-action cover clips "B" releasing lower arc shield "C" (Figure 2).
- 3 To replace movable contacts, loosen captive screws "D" and remove contact arm. Contacts are now quickly removed by twisting in either direction. (Figure 3).
- 4 With contact arm removed, stationary contacts can be replaced by dropping lower arc shield and turning contacts with wrench.
- 5 Magnet coil is easily changed by removing coil connections and loosening captive screws in coil clamps "G". Now remove armature "F" by pushing snap-in pin "E" in direction of knurled head. (Figure 4).
- 6 Stationary Magnet Frame "H" can now be removed by taking out four screws holding it to base plate.
- 7 To insert or replace an overload heater coil, remove one screw "J" and lift off cover plate.
- 8 An entire overload relay assembly can be removed by disconnecting wiring and taking out two screws holding it to the base plate.
- 9 Control circuit relay block can easily be removed from the front by taking out one screw, after moving contact arm has been removed as in Figure 3.
- 10 Entire control unit—on base plate—can be lifted from cabinet by loosening three screws "A".

Could anything be simpler?

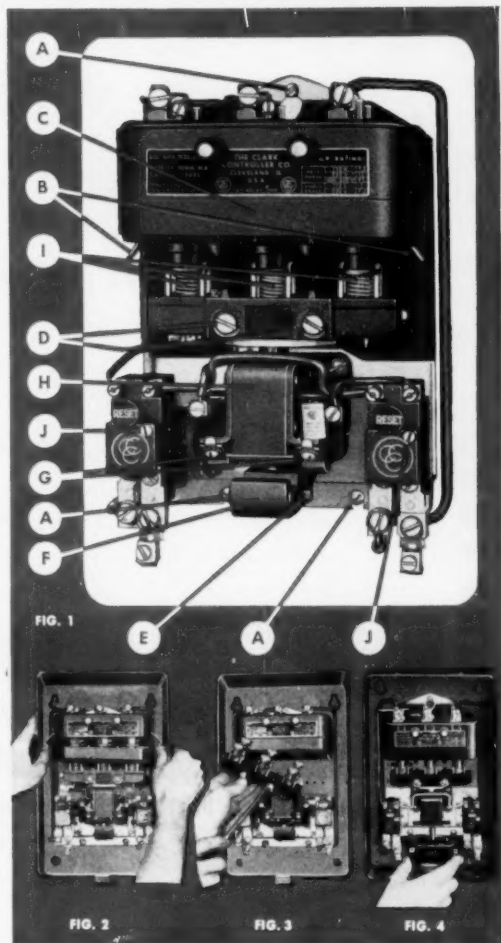


FIG. 1

FIG. 2

FIG. 3

FIG. 4



Complete accessibility from the front on CLARK Type "CY" AC Motor Starters makes a big hit with production and maintenance men. Available in sizes 0, 1, 2 and 3. Write for details.

THE CLARK CONTROLLER CO.

ENGINEERED ELECTRICAL CONTROL • 1146 EAST 152ND STREET, CLEVELAND 10, OHIO

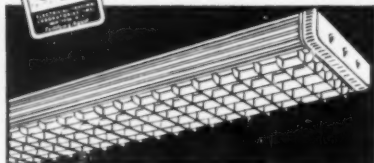


WRITE

For Complete Specifications of
the Entire **METALCRAFT** Line of
Fluorescent & Slimline Fixtures



The Series and Data Below Give
But a Hint of the Wide Scope



'White Knight'

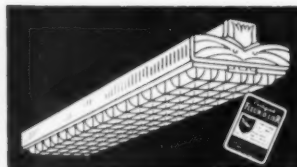
2- and 4-Lamp General Diffuse
Slimline Luminaires
Average 90% Reflectance, 80% Efficiency

SIZES: for 48, 72, 96-in. slimlines; for individual or continuous runs. Open-end raceways allow ample space for wire drawing in continuous runs, with joiners for easy ganging.

PENDANT & SURFACE MOUNTING: latter facilitated by slotted washers that simplify installation, alignment, mounting.

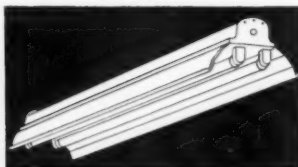
LOUVERS: hinged for easier maintenance and relamping.

One-piece top housing chassis. $\frac{1}{8}$ -in. thick ribbed plastic side shielding. Spot boxes as 4-lamp luminaire cross-section.



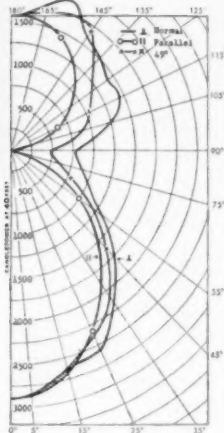
'A-L' COMMERCIAL UNIT

"FLEUR-O-LIER" approved 2- and 4-lamp general diffuse fluorescent. Average 93% reflectance, 82% efficiency. Louvered or unshielded. Pendant or surface mounting.



"SAMSON" INDUSTRIAL UNIT

Quarter-turn "Shakeproof" wing nuts speed installation and maintenance. Fluorescent or slimline. 2- and 3-lamp conventional or turret sockets. Porcelain or baked enamel.



Candlepower distribution of 4-lamp luminaire as reported by Electrical Testing Laboratories, Inc.

Electrical Specifications

would be excessive unless the circuits are very short. For circuits of larger wire the initial loading should not exceed 1500 watts for No. 10, nor 3000 watts for No. 6.

Voltage drop: The voltage drop on lighting branch circuits should preferably not exceed 2%. It is not practical to calculate the wire size for every circuit, because too much time would be required to make the calculations, and in order to avoid unnecessary complication it is better to use not more than two sizes of wire.

Some layouts provide for a larger size conductor in the "home run" from the panelboard to the first outlet on the circuit to reduce voltage drop.

Receptacles must have a rating not less than the load they serve and when connected in branch circuits must be rated as follows:

15 amp circuits—not over 15 amp rating.

20 amp circuits—15 or 20 amp rating.

30 amp circuits—20 or 30 amp rating.

50 amp circuits—50 amp rating.

Motors

Motor and heating device outlets: The size and type of motor or heating device to be indicated on the plans is nearly always determined by specific units of mechanical equipment. Therefore, the discussion with respect to design procedure for power wiring must be based on the assumption that such equipment has been definitely selected before plans are prepared.

Outlet locations: In most cases the location of machinery such as pumps, compressors, elevators, blowers, etc., is fixed because of structural or other important mechanical design features. Therefore, the motor or heating device location is largely dictated by the machinery location.

Controllers

Controller locations: Particular care must be given to locate control equipment for maximum accessibility, to save steps, and to isolate it from mechanical injury or deterioration from dripping water, vapors, etc. To meet one or more of these conditions often necessitates a carefully chosen controller location at a remote out-of-danger place. Therefore one or more remote-control pushbutton stations are usually located nearby or

More Specifications on Page 244

Metalcraft Products Co., Inc.

Mascher & Lippincott Sts. • Philadelphia 33, Pa.

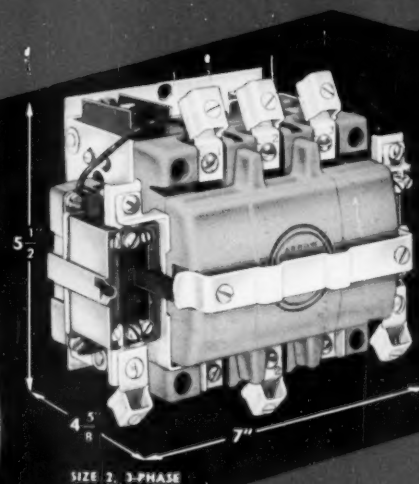
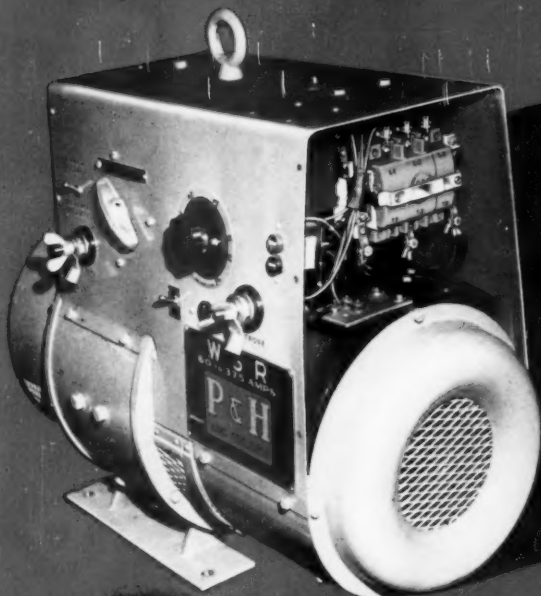
METALCRAFT PRODUCTS CO., INC., Mascher and Lippincott Sts., Phila. 33, Pa.
Please send me Bulletins and Price Lists on your complete line.

Name _____ Firm _____

Address _____ City _____

THE RIGHT CONTROL

FOR MODERN ELECTRICAL EQUIPMENT



TYPE "RA"

ACROSS-THE-LINE

MAGNETIC MOTOR STARTERS

JUST 1/2 THE SIZE AND WEIGHT OF ORDINARY STARTERS *PLUS* ADDED PERFORMANCE, GREATER DEPENDABILITY AND STRAIGHT-THRU WIRING

An ever increasing number of forward looking manufacturers have recognized A-H "RA" Starters as the *right control* for their electrical products. They are taking advantage of the many advanced "RA" features to bring out the in-built top performance of their electric motors and electrically powered machinery.

An Arrow-Hart "RIGHT ANGLE" Starter controls this P&H Arc Welder—product of the Harnischfeger Corporation of Milwaukee. *Just right* in every way for this installation, the compact starter easily fits into a limited space with plenty of room left over for easy wiring. Reduced control size leaves more space for other operating components without increasing the overall unit size.

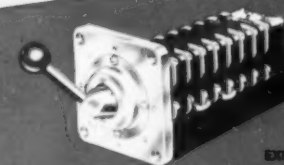
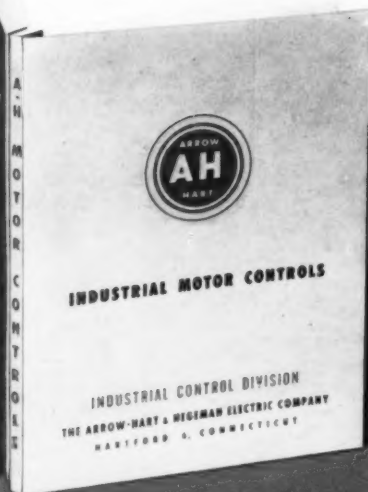
The exclusive Arrow-Hart "Right Angle" operating mechanism is more than just an "improvement"; it is the first real advance in starter design since the introduction of the original solenoid type. The result is radically reduced size and weight with increased operating efficiency and dependability. Straight-thru wiring is an exclusive, in-built A-H feature—not just a bus-bar arrangement—that permits time, work and space savings up to 30%. Safer direct routing eliminates crossover and makes circuit identification fast and positive. Starter sizes 0, 1, 2, 3 and 4 are available with a full line of NEMA enclosures for use in all atmospheric conditions.

BUY WITH CONFIDENCE • PROFIT BY PERFORMANCE
THE ARROW-HART & HEGEMAN ELECTRIC CO., HARTFORD 6, CONN., U.S.A.

HERE'S IMPORTANT INFORMATION

for

**PLANT MANAGEMENT EXECUTIVES
PURCHASING AGENTS
NEW EQUIPMENT DESIGNERS
and MANUFACTURERS
PLANT MAINTENANCE MEN
and EVERY OTHER USER of
INDUSTRIAL MOTOR
CONTROLS**

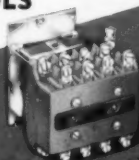


"PPS" SWITCH

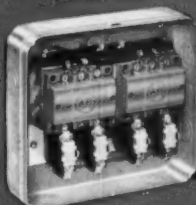
EXPLO-SAFE
STARTER



"NP" MANUAL
STARTER



"CO" CONTACTOR



PUSH
BUTTON CONTROLS



"EAS"
MULTI-SPEED
STARTER



"RT"
MANUAL
STARTER

Here is the ALL-NEW Arrow-Hart Motor Control Catalog with full information on the entire A-H line. All of the controls shown above—and many more types—are included. General description and application sections are supplemented by complete engineering data including ratings, weights and dimensions, and wiring diagrams. Additional sections will be issued to cover all new models or modifications as they are

made available. A handy ordering sheet and price supplement accompanies the catalog.

Whatever your requirement, there is an Arrow-Hart motor control complete with auxiliary equipment designed and built to do the job—and do it better. It's easy to find the right unit to do YOUR job in the A-H Catalog. Send for your copy today.

THE ARROW-HART & HEGEMAN ELECTRIC COMPANY
103 HAWTHORN STREET, HARTFORD 6, CONNECTICUT

Please send my free copy of the catalog, "INDUSTRIAL MOTOR CONTROLS"; I am particularly interested in the following type(s) of equipment: _____

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Canadian: ARROW-HART & HEGEMAN (CANADA) LTD., TORONTO, ONTARIO.

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1

Lasts indefinitely.

2

Impermeable wall and tight joints prevent corrosive ground waters from entering.

3

Light, easy to handle and tool on the job.

4

Low coefficient of friction keeps pulling tensions on cable to minimum.

5

Resists acids, alkalis, salt, grease, oil.

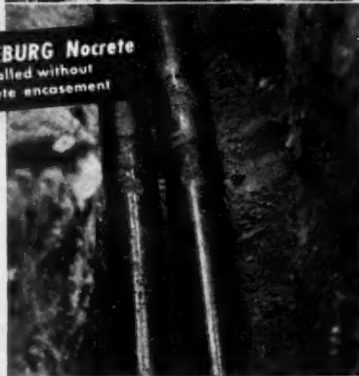
6

Lays faster and at lower cost than any other type of conduit.

ORANGEBURG Standard
installed with
concrete encasement



ORANGEBURG Nocrete
installed without
concrete encasement



"ORANGEBURG"
Fibre Conduit, a sure
profit maker for me"
says contractor

Orangeburg is a leader in every city and state.
Men responsible for protecting electric cables
know they can rely on Orangeburg Fibre
Conduit, a favorite for over 58 years.

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GENERAL  ELECTRIC
SUPPLY CORPORATION

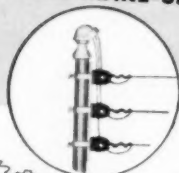
DISTRIBUTORS,
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FIRE CONDUIT
BRANCHES AND STOCKS IN PRINCIPAL CITIES

Graybar
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It's new!

PIPE MOUNTING HOUSE BRACKETS

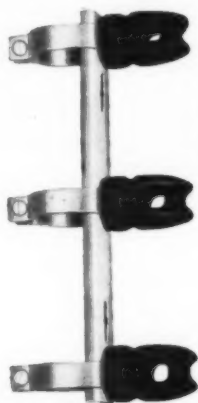
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NO MORE MAKE-SHIFT ARRANGEMENTS



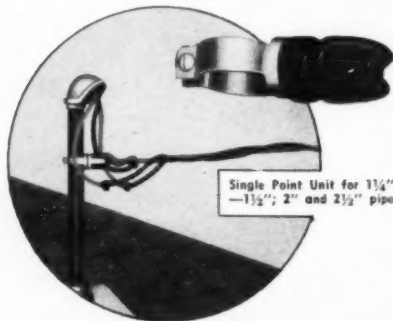
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Here's just what you've wanted all along. Porcelain Products offers you the *first* easily attached, low priced Pipe Mounting House Bracket for use wherever you fasten electrical conductors to pipe. They're perfect for residential, industrial or rural wiring jobs... ideal for ranch type housing with wide eaves. Save time...money...avoid costly delays. Write for prices, literature.



Three Point Unit $4\frac{1}{2}$ " or 6" wire spacing, for 2" and $2\frac{1}{2}$ " pipe



Porcelain Products, Inc.
FINDLAY, OHIO

Electrical Specifications

upon each machine. In addition various auxiliary combinations of limiting switches or tripping devices may be selected or may already be included as integral machine equipment. The wiring plans should indicate clearly the locations of such controlling devices and the raceway routings to be followed when wiring connections are not already provided for them on the machine.

In grouping at one location two or more assemblies of controllers, disconnecting switches, resistors, and other auxiliary devices, show on wiring plans such details as are necessary to assure the fabrication of supporting frameworks and the proper alignment or positioning of raceways.

To determine the detailed requirements for motor controllers and their disconnecting means see Article 430 of the National Electrical Code. Where a motor controller is not located within sight of its motor, the controller must usually be capable of being locked in the open position. A manually operable switch designed to prevent the starting of a motor may be located within sight of remote controlled motors. This switch may be placed in the remote control circuit of the remote control switch or switches, or it may disconnect the motor branch circuit conductors.

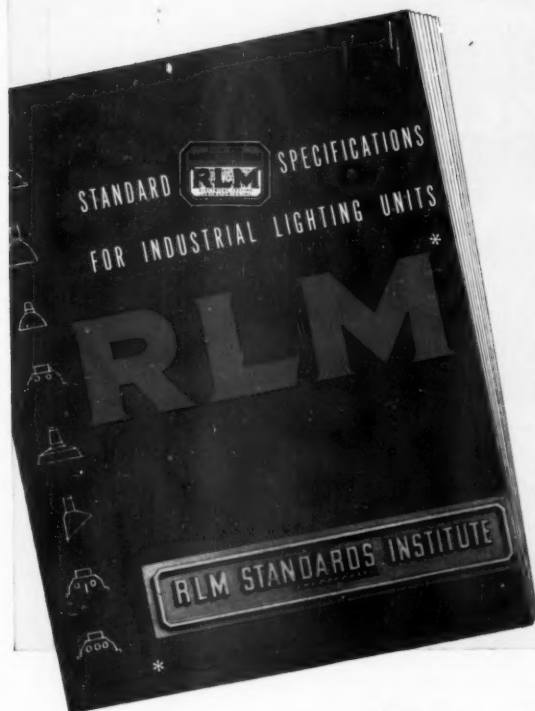
Branch circuits: Wiring connections should indicate (1) whether raceways are to be run concealed or exposed between the motor or heating device and its control equipment, (2) whether run overhead on the floor and (3) the exact location for terminating the raceway beside the motor.

Many motors and heating devices, as for printing press and laundry equipment, are mounted on machines with or without machine-mounted controllers. For such cases, particularly in concealed home-runs, the wiring plans should indicate the exact raceway termination at each machine. Where a machine is supplied with all its wiring installed by the manufacturer, state this condition, whereas the complete details of all wiring that is to be attached to machines by the wiring contractor should be indicated on the wiring plans.

For motors or heating devices that are located in areas having floors subject to seepage or prevalent moisture,

More Specifications on Page 246

The RLM Standards Institute Announces its 1952 ENLARGED EDITION of the RLM Specifications Book



Useful RLM Lighting Data:
Coefficient of Utilization Tables
Light Distribution Curves
Typical Reflector Shapes

USEFUL

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Two New RLM Specifications:
No. 4 RLM 300-1500-w Porcelain Enam-
eled Reflectors for High Mounting
No. 40 RLM 300-1500-w Aluminum Re-
flectors for High Mounting

HELPFUL

**Clarification of Ballast and Slimline
Lamp Standards on
RLM Fluorescent Specifications:**
Nos. 5, 6 RLM 48" CLOSED END UNITS
two and three-lamp
Nos. 9, 10 RLM 48" OPEN END UNITS
two and three-lamp
Nos. 22, 23 RLM 48" TWO-LAMP UNITS
with LONGITUDINAL SHIELD open and
closed end
Nos. 7, 11 RLM 60" TWO-LAMP UNITS
open and closed end
Nos. 28, 29 RLM 72" OPEN END UNITS
two and three-lamp
Nos. 30, 31 RLM 96" OPEN END UNITS
two and three-lamp

AUTHORITATIVE

**Revisions of and Additions to
RLM Incandescent Specifications:**
No. 1 RLM DOME REFLECTOR
No. 2 RLM DEEP BOWL REFLECTOR
No. 3 RLM SYMMETRICAL ANGLE
REFLECTOR
No. 18 RLM GLASSTEEL DIFFUSER

INFORMATIVE

**Easy-to-Read, Illustrated "Story of the
RLM Label":** The need for standards in
Industrial Lighting... History of the RLM
Institute... How the RLM Inspection and
Certification Program works... The Im-
portance of Porcelain Enamel... etc.



Published as a contribution to the advancement of the Science of
Industrial Lighting, and as an aid to everyone who buys, sells,
recommends or specifies Industrial Lighting Equipment.

You are invited to obtain your complimentary copy of this latest reference work on industrial lighting equipment. Architects, lighting engineers, electrical contractors, etc. recognize the RLM STANDARD SPECIFICATIONS BOOK as an authoritative aid in the specification, recommendation and purchase of industrial lighting units. It is the only industrial lighting book which helps evaluate lighting units in terms of illumination, construction and performance standards. Further, the RLM Specifications Book provides ready-made specifications which assure industrial lighting units that meet approved minimum standards of quality.

The 1952 Edition is designed to be even more helpful. It contains newly-approved specifications and latest revisions, and for the first time, valuable coefficient of utilization and light distribution data. Thus the user has at his fingertips the complete picture on each RLM unit. If

your work is concerned with industrial lighting equipment, a copy of the 1952 Edition RLM SPECIFICATIONS BOOK is available to you without cost or obligation. Write RLM Standards Institute, Suite 819, 326 West Madison Street, Chicago 6, Illinois, for your free copy.

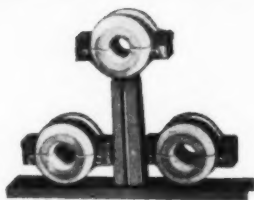


for simplicity in cable wiring jobs

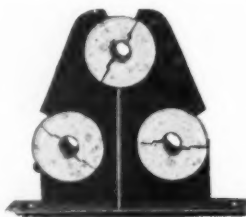
M&W CABLE RACKS



New Straight-Line type



New Delta type



Conventional Delta



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- ★ LOW INSTALLATION COST
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Write for Catalog No. 20-B



Electrical Fittings
The M. & W. ELECTRIC MFG. CO., Inc.
EAST PALESTINE, OHIO

Electrical Specifications

the raceways may in some cases be routed overhead to avoid traps or water pockets.

Outlet and equipment location: The wiring plans must show outlet locations for exit and emergency lights to comply with the National Electrical Code, state and local fire or safety regulations. The locations of equipment for non-compulsory systems such as annunciators, loudspeakers, etc., should be chosen for ready access, step-savings, audibility or visibility. Transformers, charging devices, master instruments, relay panels, and junction or distributing cabinets should be located to permit easy access for maintenance.

Circuit routings should be shown on wiring plans to indicate outlet interconnection. If future extensions to the system are contemplated, the careful routing and termination of initial circuits will greatly simplify such work later on. Unless circuit or cable runs are clearly determined on the wiring plans, frequent take-offs or multi-cable splices may be attempted which would tend to complicate maintenance.

To simplify the routing and identification of auxiliary system conductors or cables, junction or terminal cabinets should be located at accessible points.

All branch circuits that supply power to auxiliary systems, such as for signaling transformers, battery chargers, converters, or for synchronous clock systems should be clearly identified within the panelboard to prevent them becoming disconnected by mistake. This is most likely to occur at panelboards from which groups of lights are turned on and off by various persons.

Panelboard

Lighting panelboards: The simplest form of panelboard is that providing one fuse or circuit breaker for each ungrounded circuit conductor, or, for the ordinary two-wire circuit, one per circuit. For circuits under 30 amp operating at not over 125 volts, plug fuses are generally preferred to cartridge fuses as being easier to replace and occupying less space.

Branch circuit switch control at the panelboard is commonly provided

More Specifications on Page 248



here it is!

A COMPLETELY NEW APPROACH TO
OVERALL LIGHTING ...

Smithcraft area illumination

NOW . . . advanced design fulfills all the possibilities and benefits promised by overall lighting! **Smithcraft Area Illumination** is a complete fluorescent lighting system free from all the limitations and mechanical difficulties of previous attempts, yet it is not "custom built" to each installation. Skillfully engineered with unbelievable simplicity, **Smithcraft Area Illumination** when installed becomes a lighting "fixture" of limitless dimensions, shapes and patterns with unrestricted selection of shielding media and varied intensities within the system. For those who plan, recommend and install, here is an important new tool and business-producer; for the user, **Smithcraft Area Illumination** opens up exciting new possibilities for effect combined with illumination of unequalled quality.

architects

To the architect, **Smithcraft Area Illumination** presents a new opportunity for freedom of expression in the integrating of lighting interiors within interior design. Here is freedom of choice with no restrictions as to size, pattern, intensity, shielding, and periphery.

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Engineers can now specify and get any required level of intensity. Or different intensities for different sections of an installation may be recommended to permit optimum usage of store or office areas. Alternating light, rows of lighting, or banks of lighting are possible because of flexibility of switching and a specially designed wiring system.

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Ease and economy of installation are truly amazing! **Smithcraft Area Illumination** is actually installed in far less time than any combination of ceiling and illumination currently available. No careful dimensioning is required and no special tools, rules, or gadgets. From the time the hangers are in position on the ceiling to the finished installation, only a water level and small screwdriver are required.

owners

For those who own buildings and businesses of many kinds, **Smithcraft Area Illumination** is a profitable and practical investment. Versatile and adaptable, here is highest quality illumination combined with appearance and effect that sells and produces. Its ease of maintenance and adaptability to future plans and developments are factors that interest any businessman. Yet, its initial cost is comparable to that of a suspended ceiling and troffer system.



Send now for further information on **Smithcraft Area Illumination**.

America's finest fluorescent fixtures **Smithcraft**
LIGHTING DIVISION
CHILMARK 50, MASSACHUSETTS

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EASTERN TUBE & TOOL CO., INC.

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Electrical Specifications

in retail stores and in large spaces where it is convenient to have a single point of control, except where a more elaborate control system is called for, as in a theatre or other assembly hall. In an apartment building, hospital, or school building, local control by means of wall switches is necessary and circuit switches on panelboards are usually single-pole.

Branch circuit breakers provide both overcurrent protection and individual circuit control.

Panelboards can be obtained with main fuses or a main circuit breaker. Such equipment is usually the most practical means of providing overcurrent protection for a panelboard where such protection is required. A main switch or circuit breaker may be useful if all circuits are to be controlled together; for example, a panelboard supplying show window lighting only.

Spare circuit equipment should be provided on every panelboard amounting to at least one spare circuit for each five circuits utilized in the original layout. Where the cabinet is built into the wall, provisions should be made for bringing this number of circuits out of the cabinet without channelling to finished wall. Such provision may consist of empty raceways run up from the cabinet to covered outlet boxes located in the ceiling, or run down to boxes in the ceiling of the story below, or both; or by leaving space for two additional wires in each run from the panelboard to the first outlet.

Each of the following considerations shall be given due weight in determining the required number of panelboards and their location:

Good practice limits the number of branch circuits distributed from one location or panel to a maximum of 42.

No branch circuit run from the cabinet to the first outlet should exceed 100 ft.

Panelboards should always be accessible for the replacement of fuses or the resetting of circuit breakers. If circuit switches or circuit breakers are to be used for the control of lighting equipment, convenience of access for this purpose should also be considered.

Panelboard locations should be so

More Specifications on Page 250

Specify Pemco

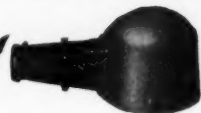
For the newest and finest in modern design, for superior workmanship, for practical application and satisfactory service, always specify Pemco.



NEW! Exclusive Pemco design Service Station fluorescent island light with selling sign that carries interchangeable message! In 4', 8', 12', 16' units. Patent Applied for.



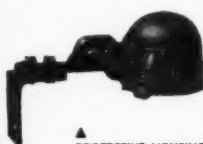
▲ **ATTRACTIVE** and efficient! Pemco's Deluxe Alzak aluminum floodlights guarantee maximum light output. Available in 65° to 110° beam spread. Weatherproof, bug-proof construction, built for lasting service!



▲ **INTERCHANGEABILITY** and adaptability keynote modern Pemco street lighting luminaires. To meet changing requirements, modern hood illustrated above can be fitted either way shown. Designs like these reduce parts warehousing, simplify change-overs.



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▲ **PROTECTIVE LIGHTING** equipment by Pemco features rugged construction, efficient design, usability. Bracket here can be adjusted horizontally or vertically with interchangeable luminaires shown.

◀ Street-lighting standards built to last! From Pemco's 68 years of experience, we recommend Union Metal standards, available in sleekly appearing steel or aluminum in round or octafute shape, and American Concrete standards.

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Please send me a copy of Catalog No. 90. I am particularly interested in (check, please)

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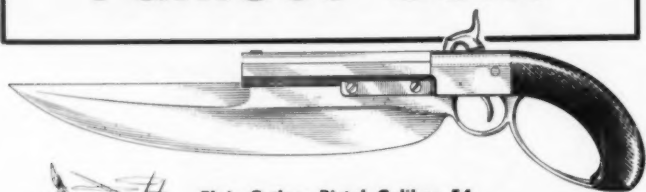
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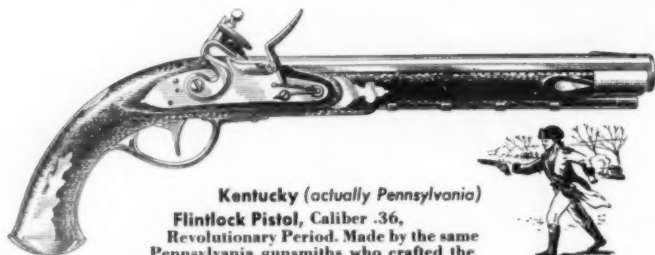
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Elgin Cutlass-Pistol, Caliber .54, 1837 Model, made by C. B. Allen. Invented by George Elgin of New York, this formidable arm was intended to take the place of the cutlass and pistol commonly used by naval boarding parties. One of several variations of this weapon is the shorter Bowie-Knife Pistol.



Kentucky (actually Pennsylvania) Flintlock Pistol, Caliber .36, Revolutionary Period. Made by the same Pennsylvania gunsmiths who crafted the famous "Kentucky" rifles, these full-stocked pistols actually were rifles-in-miniature. Every "Kentucky" pistol is unique; the same gunsmith never made two alike.



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for light or heavy work. Dual heat greatly increases tip life. Switch instantly to high or low heat as job requires. Pre-focused spotlights end "blind soldering". Exclusive tip-fastening arrangement assures full, constant heat. Shatter-proof plastic housing. Perfect balance. Low-cost, replaceable tips. Pays for itself in a few months. See at your Distributor or write for Bulletin direct.

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The Finest Soldering Tool for the Finest Craftsmen

Electrical Specifications

chosen that the feeders will be as short as possible and may be brought to the panels with a minimum of expense for bends and offsets. It is difficult and often impossible to install large conduits concealed in the floor.

In a small building consisting of one story and a basement, a single panelboard located on the main floor may be sufficient. For larger buildings, one panelboard per floor may be considered the minimum.

Lighting feeder capacity: The minimum sizes of feeders to provide for carrying capacity are to be based upon a load of 1,000 watts for each 15 amp branch circuit installed, plus the total initial wattage of all heavy-duty lamp circuits, plus 500 watts for each spare circuit provided on the panelboard.

A demand factor as permitted by the National Electrical Code may be applied to the total wattage. This demand factor will be 100% for all retail stores and for small buildings of any occupancy.

Having determined the maximum demand in watts (total computed wattage x demand factor) for each feeder, the current per feeder is calculated as follows:

Two-wire, 120 volt system

$$\frac{\text{Watts}}{120} = \text{amp.}$$

Three-wire, 120-240-volt system

$$\frac{\text{Watts}}{240} = \text{amp.}$$

Four-wire, three phase, 120-208-volt system

$$\frac{\text{Watts}}{360} = \text{amp.}$$

Voltage drop: A voltage drop should not exceed 1% in the feeder system from the service entrance to any panelboard. Using the maximum demand amperes computed as explained above, the size of conductors required for 1% drop should be calculated and this size should be used if it is larger than the size required for carrying capacity.

Provide for future increase in feeder capacity. All branch circuit calculations are based upon a possible future increase of 50% in the load on 15 amp circuits and the substitution of lamps one size larger than the original lamps on heavy-duty lamp circuits. In order to make it possible to use this excess circuit capacity, provision must be made for a corresponding in-

More Specifications on Page 252

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JEFFERSON



TRANSFORMERS for Mercury Vapor Lamps

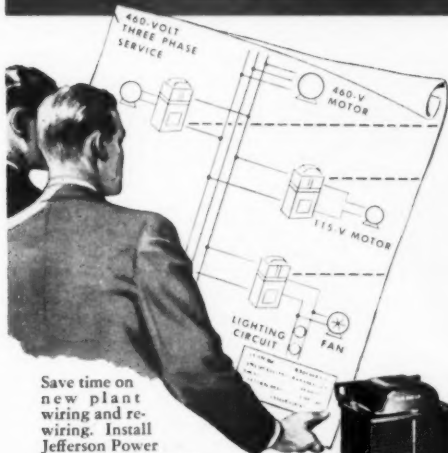


Types are available for indoor or outdoor lighting and multiple or series circuit street lighting... Designed and manufactured by transformer specialists with over 35 years continuous experience... Engineered to coordinate exactly with specifications of the lamp manufacturers... Assurance of correct starting and operating performance for long-life, high efficiency lamp operation.

Single and two-lamp—normal and high power factor—transformers. Plus and minus taps are provided on the primary side to permit exact matching to the line voltage. A design for every installation whether Indoors or Outdoors. Complete details in new catalog 521-5.



TRANSFORMERS—Dry Type for Power Circuits



Save time on new plant wiring and re-wiring. Install Jefferson Power Circuit Transformers to provide the 110-115 volt service for lighting, controls and portable equipment in plants or buildings where higher voltage circuits (230, 460, 575) are employed. Save copper, manpower and steel. Write for Bulletin 501-15.



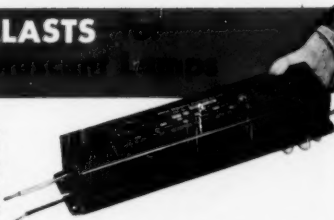
BALLASTS

A complete line of normal and high power factor ballasts is available for the efficient operation of all standard sizes of fluorescent lamps.

Single and two lamp high power factor ballasts are available for the operation of all types and sizes of Slimline lamps.

Series Sequence Ballasts for the improved operation of two 96T12 and two 48T12 lamps are the latest additions to the Jefferson line.

All Jefferson Ballasts are certified by E.T.L. and approved by Underwriters' Laboratories. Series Sequence Ballasts meet the requirements of the proposed American Standard Association Test Specification C82.1 and Supplement No. 1.



TRANSFORMERS

The ONE Jefferson Universal-Mounting WIZARD Bell Transformer for operation of door bells, buzzers, annunciators and door openers replaces THREE models. The patented mounting feature for clamping to the edge of a knock-out provides for installation on an outlet box or cover or cabinet—mounting feet make surface mounting feasible. Chime transformers with greater voltampere capacity and with the same constructional features are also available.



FUSES

- THERMAL.—SAF-T-LAG
- RENEWABLE.—SUPER-LAG
- RENEWABLE.—JEFFERSON-UNION
- NON-RENEWABLE
- FUSTATS • PLUG FUSES

Select the type for your particular needs

The Jefferson SAF-T-LAG is a heavy-duty Thermal Non-Renewable Fuse with an extra Safe-Time-Lag to protect equipment and machinery—it acts positively on dangerous overloads yet prevents premature and unnecessary blowing on harmless, temporary overloads. The copper elements used have much lower resistance than conventional zinc elements providing 50% lower watt loss and cooler operation.

Jefferson SUPER-LAG Renewable Fuses with the long time lag for motor loads and UNION Renewable Fuses for circuits where voltage surges are not a factor. A minimum number of parts permits quick and easy renewal.

Where overloads are not a frequent occurrence, as for lighting circuits, the Jefferson Non-Renewable Fuse is the choice for economical, dependable service.

The Jefferson Fustat prevents tampering or over-fusing. It has a built-in thermal cutoff which provides a long time lag. Made in capacities of .3 to 30 amperes, for 115-volt circuits.

Plug Fuses, well-made of strong molded insulation,—3 to 30 amperes, for 115-volt circuits.



JEFFERSON ELECTRIC COMPANY, Bellwood, Illinois

In Canada: Canadian Jefferson Electric Co., Ltd., 384 Pape Avenue, Toronto, Ontario

crease in the feeder capacity. This may be done (1) by installing oversize feeders originally, (2) by installing oversize conduits so that the original feeders may be replaced with feeders of larger size, or (3) by arranging the installation so that additional feeders can be installed at some future time at a minimum of expense.

(1) Where the conductor size required for the initial load is No. 8 or smaller, conductors large enough to provide for the future increase in load should be provided in the original installation. The additional cost of the larger conductors in such a case will be so small as to be unimportant.

(2) Up to a conductor size of about No. 1, conduits should be installed of sufficient size to contain feeder conductors of the size required for the future increase in loading. This will usually require, if the three-wire system is used, 1½-in. conduit for No. 6 or No. 4 conductors and 2-in. conduit for No. 2 or No. 1. Then when the need arises the original conductors can be withdrawn and replaced with conductors of larger size.

(3) Where the conductors are replaced as in (2), the original conductors have only a scrap value. To avoid this waste in the case of large cables, spare conduits may be installed so that the increased capacity may be provided by installing additional feeder cables. This method, however, requires that the original layout be planned with special care. It is not good practice to multiple two conductors of unequal size, hence the installation should be planned to utilize the additional feeder capacity by sectionalizing each panelboard or by changing the connections so as to supply certain panelboards by the new feeders.

Power feeders: Because of the varying factors in power feeder design as to routing, grouping of motors and voltage loss, five common methods of design or types of layouts must be considered.

(1) A separate circuit may be run to each motor from a branch circuit distribution center.

(2) A feeder or sub-feeder may be carried around the building with branch circuits tapped to the feeder at various points, no branch circuit

More Specifications on Page 254

"I am typing a lot of orders to QUADRANGLE these days"



SPADE SIGN REFLECTOR

Designed for small and medium sized signs this unique one-piece reflector is ideal for store-front transoms. Streamlined, yet inconspicuous, it does not obstruct view of sign. Rust-proof, weatherproof, easy to wire, it mounts on a shorter ½" pipe arm. Light distribution is wide on the sign with straight line cutoff at upper edge.

QUAD Sign Reflectors

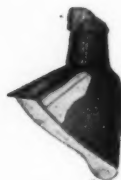
This typist can't help but be impressed when she sees those QUAD orders come thru. The 15 different sizes and shapes of QUAD SIGN REFLECTORS sell well because they deliver good lighting and there is always the right type for the job. They range from six-inch round for 40 watt lamps to 18-inch rectangular for 1500 watt lamps. Permanent porcelain enamel finish throughout this line—green outside and a lustrous white inside reflecting surface. Fittings are thoroughly rustproof.

SPECIAL FEATURES

In addition to the type "H" socket-fittings for attaching to horizontal pipe shown on the round and rectangular reflector pictures, there are also available "V" fittings for suspending reflectors on vertical pipe and "B" socket-fittings for mounting direct to outlet box.

Reflectors are removable and interchangeable on all three types of socket-fittings. Easy wiring and installation features make them especially suitable for sign work.

For suggestions on the application of QUAD Sign Reflectors and data on sizes, send for Bulletin No. 8.



RECTANGULAR SIGN REFLECTOR

Widely used for wall signs and bulletin boards, these reflectors produce a uniform distribution of light over a wide vertical area. The contour is such that a straight line cutoff of light at the top of sign is obtained without spillage, scallops, or shadows. Signs range from 50 Watts to 1500 Watts.



ROUND ANGLE SIGN REFLECTOR

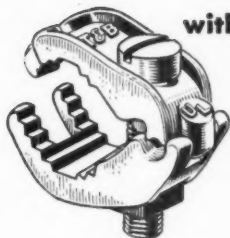
Generally used for gasoline station advertising, these efficient reflectors are in service everywhere—lighting all kinds of signs from "Tourist Rooms" to full sized bulletins. The forty-five degree axis of light distribution insures proper lighting at the bottom of the sign. Sizes range from 40 Watts to 500 Watts.

QUADRANGLE MFG. CO.

375 S. PEORIA ST.

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HANDLE LOTS MORE grounding jobs in lots less time



with multi purpose,
easy-to-use T & B Ground Clamps*

Take along just *two* types of T & B Clamps—and you can take *on* 'most any grounding job! #3846 handles #6 or 4 bare wire... #3847, #8, 6 or 4 armored. Both make a tight, lasting, *non-crushing* connection to copper tubing... water pipe... ground rod—in $1\frac{1}{2}$ " and $\frac{3}{4}$ " sizes.

Tighten just *one* screw on a #3846 for an electrically sound, mechanically durable joint between wire and electrode. Tighten just *one more* screw on a #3847 for a lasting grip on the armor too!

One-piece construction—no loose parts to get lost. Ideal for installation in dark, cramped quarters.
UL approved, of course!

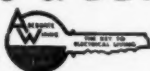
ENGINEERED RIGHT... DISTRIBUTED RIGHT!

Ground Clamps #3846 and #3847 are typical of the many T & B quality fittings recently re-designed to give you outstanding performance at lowest installed costs. Like all T & B fittings, they're furnished under the T & B Plan 100% through your local T & B distributor.



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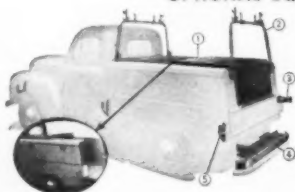
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ZIEGLER BROS. ELECTRIC, POMONA, CALIF.



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If your present truck equipment isn't adequate for your work, why not get the full story on the efficient Service-Master Body? Just clip the coupon below . . . paste it on a post card . . . and mail it. You're under no obligation, of course.

OPTIONAL EQUIPMENT



1. Removable overhead rack.
2. Telescopic roof and end-gate enclosure.
3. Removable vise bracket with pipe support.
4. Rear bumper with safety-tread step.
5. Side-mounted pipe carrying brackets.

Look at all the features you get in a POWERS Service-Master:

Fully enclosed wheelhousings protect underside of compartments and strengthen side panels; one-piece, ribbed-steel floor distributes weight evenly and prevents sagging at any point; all-steel body shell is electrically welded to form one complete unit; can be mounted on new or used chassis and easily transferred from one unit to another.



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DEF

Electrical Specifications

distribution center being used. Busbar distribution systems with taps to individual motors come within this group.

(3) A feeder or sub-feeder may be carried around the building with sub-feeder taps, having no individual overcurrent protection, carried direct to the disconnecting means or controller for each motor. In this case, the branch circuit overcurrent device is usually omitted and the motor branch circuit originates at the controller.

(4) A feeder or sub-feeder may be carried direct to the disconnecting means of controller for each one of the group of motors. Otherwise the layout is the same as in (3).

(5) A group of small motors, each having a full-load current rating not exceeding 6 amp, may be supplied by a 15 amp branch circuit or an appliance circuit. For conditions under which each of the foregoing types of layouts can be used and installation requirements applying in each case, see the National Electrical Code.

Application of various types of layouts: Type (1) can be used under any condition and is the type most commonly used. It is usually the preferable type for supplying the miscellaneous power loads in a commercial or public building, and is also common in industrial plants.

The use of Types (2), which includes busbar distribution systems, (3) and (4) is chiefly in industrial plants where a large number of motors is used to drive individual machines. Type (2) requires for each motor a branch circuit overcurrent device. In Type (3), no branch circuit overcurrent device is required, but the conductors from the sub-feeder to the controller must be larger than in Type (2). The Type (4) may show an economy in cost over either Type (2) or Type (3) if the sub-feeder can be economically brought to each controller.

Type (5) is merely a means of providing for small motors used with household and commercial appliances, by permitting them to be connected to lighting or appliance branch circuits. This is not to be considered as a type of layout having application in a factory.

For power applications in industrial
More Specifications on Page 256

DUTCH BRAND

"DB" Wire Connectors and Electrical Tapes

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- Solderless • Vibration-proof • Weatherproof
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PLASTIC Tape is super thin, has up to 200% stretch, has high dielectric strength and it conforms readily to irregular shaped surfaces. Perfect for application where space is limited. It resists weather, water, oils, acids and corrosive chemicals. It is available in regular .007" thickness and heavy duty .010" thickness for winding heavy cables, heavy electrical harness and for use with power driven tape winding machines. It is packaged in master shop packages, in counter displays and Jr. shop packages for "Tool Kit" size rolls.



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DUTCH BRAND Friction Tape is the quality product which enjoys an enviable reputation for performance. It is long lasting, sticks tight, tears straight, wraps neatly, does not ravel and has tensile strength to exceed requirements.



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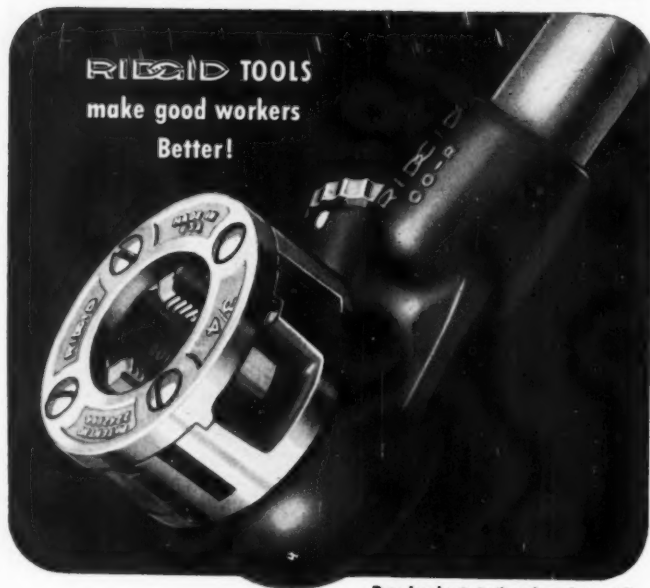
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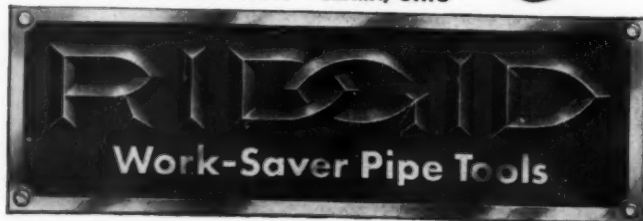
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Bolt Dies 00R-3
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Electrical Specifications

plants, the first four types of layouts may be considered as on a par as regards serviceability. The choice between these types should be made on the basis of economy in cost of installation and flexibility, i.e., adaptability to changes in sizes and locations.

Voltage drop and carrying capacity of conductors: All conductors must have sufficient carrying capacity, according to the National Electrical Code requirements, and should also be of such size that the total voltage drop to any motor will not exceed 5%.

On any system operating at 208 volts or higher, it is recommended that the voltage drop in motor branch circuits should not exceed 1%, in which case a drop of 4% in the feeders is allowable. It will be found that with the minimum conductor sizes permitted by the National Code, the feeder voltage drop will exceed the 4% limit only where a feeder is unusually long. In any case where the drop will exceed 3%, the annual cost of the kilowatt-hours consumed in copper losses should be computed and consideration should be given to the installation of larger conductors in order to reduce this loss.

In an industrial plant it is almost always desirable to install service and feeder conductors of larger sizes than are required for the initial load. Besides providing for load increases, the excess size will also have the advantage of reducing the copper loss.

Assemblies of externally-operable switches or circuit breakers are adaptable to all installations, small or large.

Suitable provision should be made for the protection of feeders of increased size. All that is necessary is to provide space for the future installation of larger switches or circuit breakers, and means of making connections to the larger equipment without disturbing such of the original equipment as may be retained. If a panelboard is used, it is suggested that it be of the sectional type, with space in the cabinet to contain the larger equipment and with buses large enough to carry 150% of the initial load. If a switchboard or assembly of unit devices is used, it is suggested that the buses be as recommended for panelboards and that the switchboard or assembly be specially designed to

More Specifications on Page 259

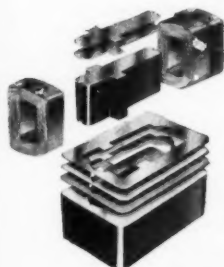
check list of
lighting transformer
values

SOLA
ELECTRIC CO.

Lighting
TRANSFORMERS

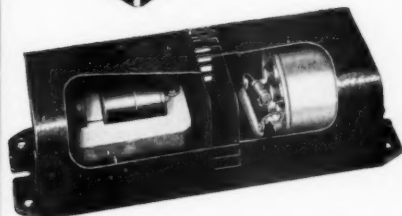
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Physically isolates the capacitor from core-and coil heat, greatly increasing capacitor and, consequently, ballast life.

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- Ventilated capacitor compartment

WRITE FOR SPECIFICATION BULLETIN JPFL-161

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FLUORESCENT LAMP

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Constant Wattage & Conventional Types



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A flanged two section cylindrical design readily adaptable for any type of mounting. Single lamp types.



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Compact design suitable for mounting in any desired manner. Several types for operation of a single lamp or two lamps.

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An outstanding application of the patented Sola circuit, designed to operate over the primary voltage range without the necessity of primary taps. Exclusive advantages are:

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"From Molten Metal To Finished Product"

Electrical Specifications

accommodate the larger equipment.

Service: The first step in determining the size of the service conductors and the capacity of the service equipment (switch and fuses, or circuit breaker) is to compute the total initial load by totalling the feeder loads. These should be the loads computed for the various feeders before any permissible demand factors less than 100% have been applied. Any power load should be segregated. By "power load" is meant any load consisting of motors or electrically heated equipment that is not to be supplied by "15 ampere" or "appliance" branch circuits as defined in the National Electrical Code.

The demand factor permitted by the National Electrical Code should be applied to the total load other than power load. In most cases, no demand factor less than 100% should be applied to the power load. For a single service supplying a combined load of lighting and power, the total capacity will be the sum of the lighting load after applying the demand factor, and the power load.

Provision for increased capacity: Provision having been made in the other portions of the wiring system for a future increase in the lighting load, provision should also be made for a similar increase in the service capacity.

The original installation should include service entrance conductors and service equipment having the required excess capacity in every case where the rating of the equipment, as thus determined, will not exceed 400 amp.

Where the calculated future load exceeds 400 amp, an individual study should be made of each case. Due weight should be given to each of the following considerations:

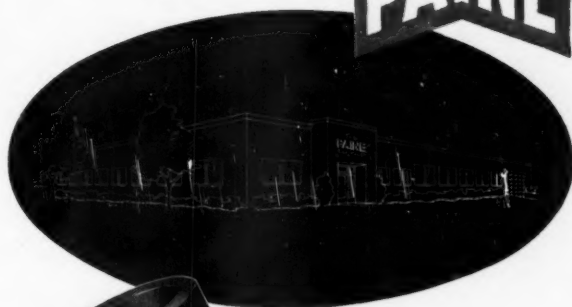
(a) In any building having an expectant life of ten years or more, it is highly probable that some additional service capacity will be needed.

(b) In most cases, additional capacity can be provided only by tearing out and completely replacing the original service conductors and service equipment and the larger the service, the greater the expense involved.

(c) Considerable additional expense is involved in providing 50% excess capacity in the case of a heavy service and this is a non-productive investment until some part of the excess capacity is utilized.

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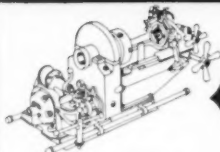
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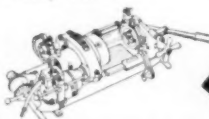
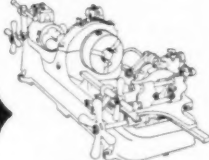
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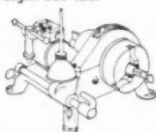
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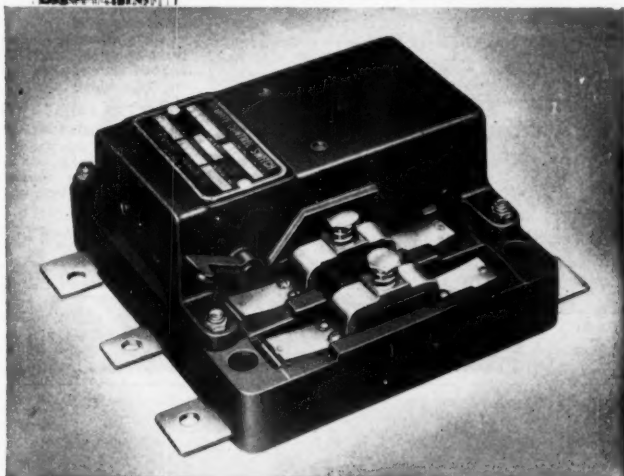
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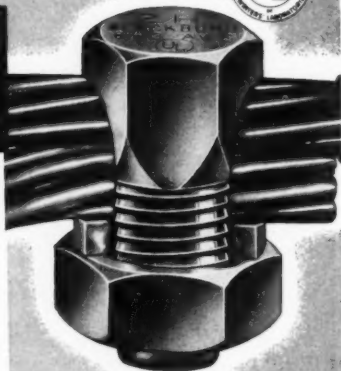


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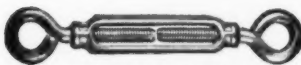
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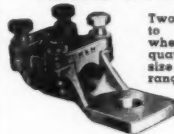
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is no better than its
Connections*

DUPLIX LUGS

Square end—one or two attaching bolt holes. Accurately machined all contact surfaces parallel. Receives two or more conductors of different sizes with equal pressure. Wire sizes 4-1 to 900,000CM.



FLEXIBLE CLAMP LUGS



Two or four bolts, designed to meet requirements where a single lug adequately applies to several size conductors. Cover range of wire sizes from 1-1/2 to 2,000,000CM solid or stranded.

PRESSURE TYPE CAST CLAMP TERMINAL LUGS



One or two bolt holes. Lugs one piece designed for one wire size to give conductivity and contact surface equal to capacity of wire. All contact surfaces ground, faces parallel, wire sockets machined. Wire sizes 1 to 2,000,000CM.

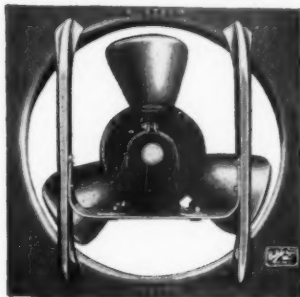
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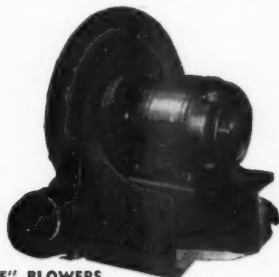
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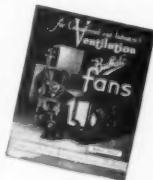


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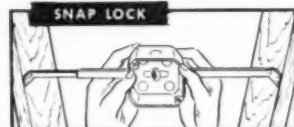
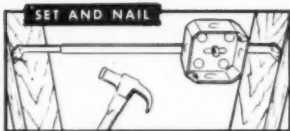
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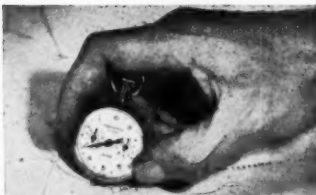
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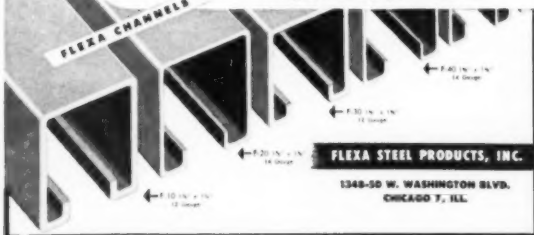
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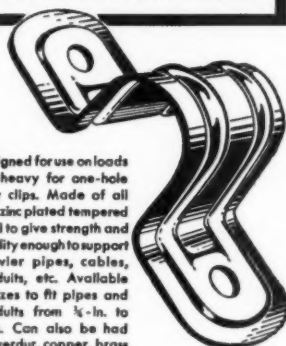
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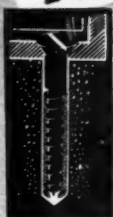


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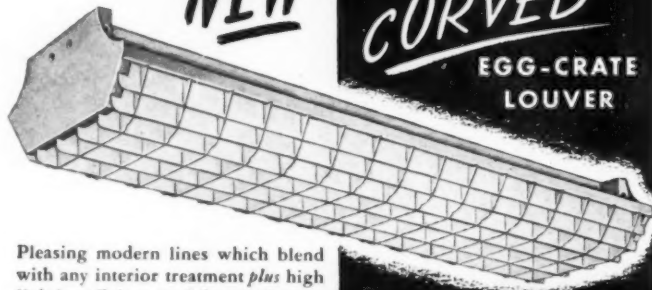
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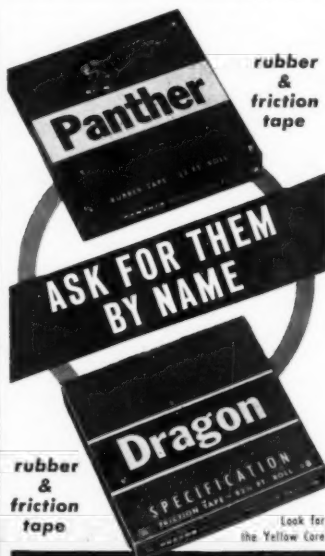
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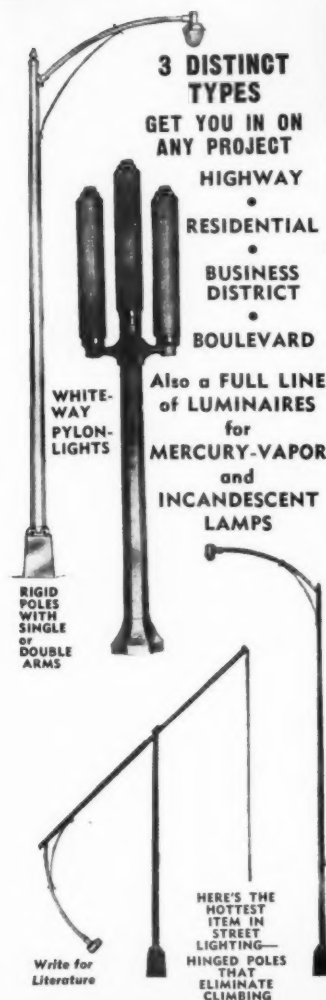
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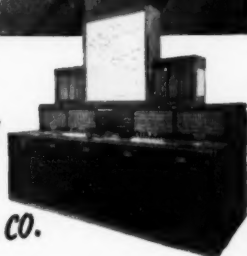


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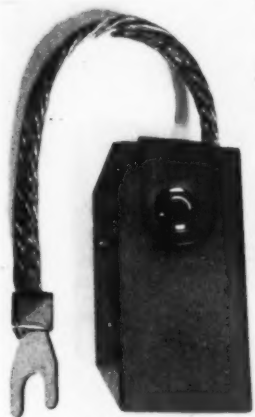
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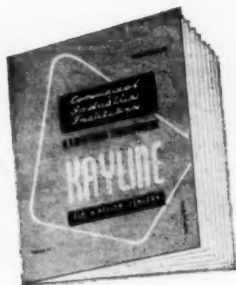
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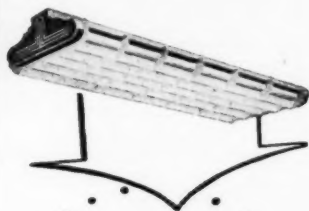


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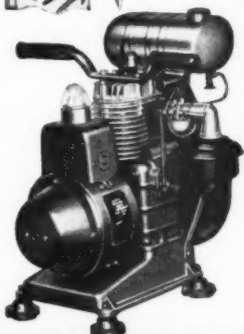
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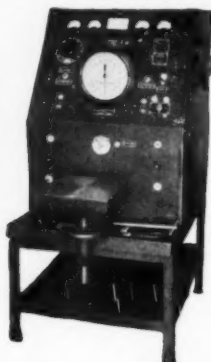
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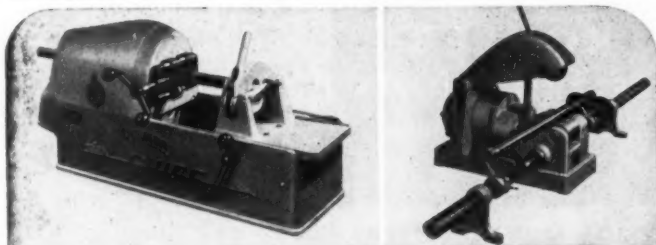
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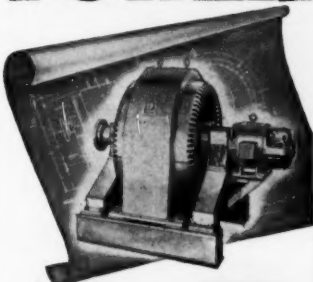
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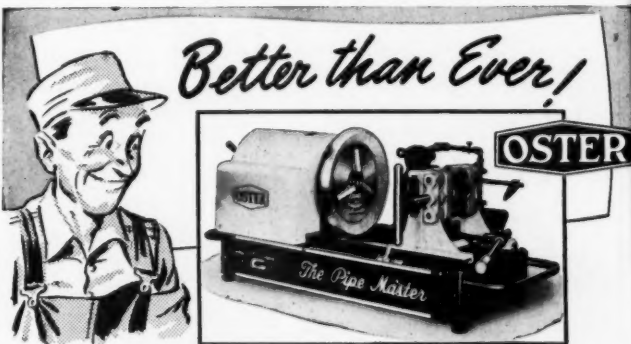
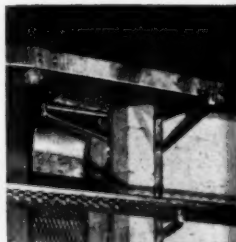
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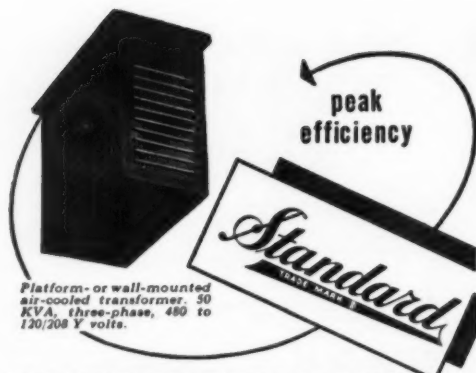
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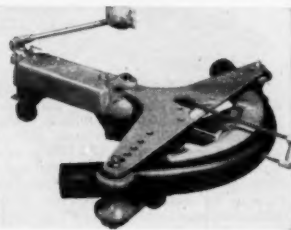
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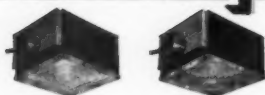
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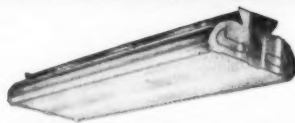


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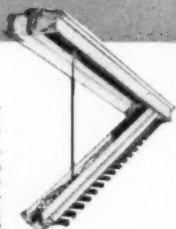
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When you specify GUTH Luminaires, you get the benefit of more than a half-century's experience in pioneering better lighting. We make good specialized equipment for every lighting need...all precision-planned for economical installation and maintenance:

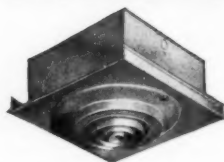
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WYTE-LINER ...white inside and outside (takes gloom off ceiling). AIRFLOW channel for longer ballast life. Reflectors 300° Permalux or Porcelain Enamel. Made in 2 and 3 40-watt, 2 85-watt, and 4- and 8-ft. SLIMLINE lamps. Easy to install and clean. Catalog 48.

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"LITE-BLOX" RECESSED TROFFERS ...for 1, 2, 3 or 4 lamps: 20-, 40-, 85-watt, or 4-ft., 6-ft., or 8-ft. SLIMLINE. Exclusive end KO's provide exact 48.0"; modular design for unlimited patterns. Wide variety of shielding and diffusing glass panels available; also ALZAK reflectors if desired. Bulletin 869.

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Modern Lighting

Showroom Installs Slimlines Above Louvercell Panels

Homer Heller's Ford agency in San Diego, California, is distinguished by the liberal use of glass, color and light. Occupying a strategic corner location, it includes a 1400-square-foot main display floor, a "band box" window with highlighted turntable for effective car presentation, and several attracting and attractive illuminated signs.

The corner showroom, measuring 30 by 48 feet, is a 75-foot-candle area. T8 slimline lamps operating at 200-ma are mounted in continuous rows on 16-inch centers above the wall-to-wall installation of 2-by-2-by-2 inch cellular louvercell. The lighting load of 6.2 kw results in a 4.3 watts per sq. ft. distribution. Since this 75-ft overall intensity is ample, no addi-

tional lighting is utilized for local illumination or for highlighting. Glass walls, extending from adjacent sidewalk levels to the 13-foot 8-inch ceiling height, enclose two sides of the sales area while interior walls of pastel green and coral tile provide a restful, complimentary background. Reflectance factors are: 85% for the plaster ceiling above the slimline single-channel installation, 45% for the coral wall, 30% for the green wall.

The band-box display window, at the left in the bottom picture, is illuminated by 15-watt R40 incandescent lamps recessed in the general ceiling and mounted in swivel hoods along the front edge of the window. In all, 26 lamps have a connected load of 3.9-kw and deliver 145 footcandles.



CELLULAR CEILING and slimline installation operating at 200-ma provides 75-ft-c lighting for attractive corner showroom.



MODERN SIMPLICITY and the liberal use of glass, color and light distinguishes Homer Heller Ford Agency in San Diego.

I just can't imagine
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by actually trying it.

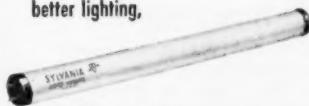


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COVES along both sides of Helena Rubinstein's Chicago beauty salon and along front edges of display counters and wall cases, with recessed ring-louvered R lamps above the counters and entrance, result in even general illumination and effective highlights for merchandise presentation.

Variety Exhibited In Salon Lighting

Customers entering Helena Rubinstein's Chicago beauty salon rarely are conscious of the lighting installation as such, yet they are definitely impressed by the quality and quantity of illumination in the area generally and within the cases for effective product presentation. For the lighting has been treated as an architectural element combined with coves, cornices, niches and false ceilings to pleasingly produce color and high-level seeability without revealing "tools of the trade" or brightness sources to the public.

Along one side of the salon, behind and above two glass-topped display cases, a wide and deep cove provides a blanket of indirect general light. Three rows of end-to-end 40-watt fluorescent lamps are installed here, with sockets staggered to prevent the formation of a shadow pattern on the ceiling. Switching control is by rows, making it possible to obtain three levels of illumination from this concealed linear source. On the other side of the shop, a slanting cornice is supported several inches out from the natural wood wall, with twin rows of fluorescents behind it. Above the front edge of the display cases and above the all-glass entrance, 150-watt R40 incandescent lamps are mounted in recessed ring-baffled Century downlights to add warmth of color and sparkle to merchandise placed on counter tops for critical inspection.

The inside of the counters are illuminated by continuous lengths of 25-mm 4500-degree white cold cathode tubing, bent to conform with

counter contours and concealed in specially designed parabolic reflectors that snugly hug the lead edges. Lamps operate at 120-ma and ballasts are located beneath and at the ends of counters. Wall display cases behind the counters normally concealed by sliding mirrored panels, are illuminated by 6-foot vertical and 4-foot horizontal slimline lamps, also operating at 120-ma, positioned behind bordering shields. Light levels within the salon generally average 30 foot-candles; display cases, 65-fc.

The lighting was planned by Fred C. Damier and installed by the Electrical Contractors, Inc., Chicago.



ATTRACTIVE LIGHTING is provided by large corrugated Plexiglas ceiling sections at the National Bank, Temple City, Calif. The 24-inch by 48-inch by .125-inch white acrylic plastic panels are mounted 3 feet below 60-watt incandescent lamps spaced on 3 foot centers. Partitions at front of bank are also corrugated white translucent Plexiglas panels, 60-inch by 36-inch and 60-inch by 72-inch.

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Strong Domed Covers are warped and Body Cover joints are ground flat for tight gasket seal. Heavy hub sections of ample cross section are tapped straight and true with accurate, clean cut, TAPERED threads.



Dowel-pin type self-retaining screws provide easy alignment of covers—hold cover and gasket together during handling.

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5. CAST METAL SAFETY SWITCHES AND CIRCUIT BREAKER PYLETS—Heavy duty safety switches and fuse boxes with or without plug receptacles and circuit breaker Pylets with all features for reliable service under severe conditions. Safety switches have quick make and break, interlocked cover and weathertight gaskets on both cover and hub plates. Available with interlocking plug receptacles.

Refer to your Pylet Catalog 1100 for complete listings including plugs and receptacles—explosion-proof pylets, cord and cable grips—flexible conduit couplings—unions—reducers—elbows and grip handles—portable hand lamps.

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Questions on the Code

Answered by

B. A. McDONALD, New York Board of Fire Underwriters, Rochester, N. Y.

GLENN ROWELL, Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.

B. Z. SEGALL, Consulting Electric Engineer, New Orleans, La.

F. N. M. SQUIRES, New York Board of Fire Underwriters, New York, N. Y.

Convenience Outlets

Q. A liquefied petroleum gas bulk plant having four 30,000 water gallon storage tanks wants to install, within the fenced enclosure about these tanks, receptacles into which they may plug extension cords attached to head bolt heaters on their trucks to keep the engines warm during cold weather. How far away must I insist these convenience outlets be located if I accept other than explosion-proof Class I, Group D devices?—J.M.C.

A. While there actually are no specific regulations contained within the National Electrical Code covering such an instance, I believe personally that if we follow Section 5413 as it pertains to gasoline dispensing or service stations, we can be relatively safe in assuming the installation will be safe. In other words, if these outlets can be placed 20 feet or more horizontally distant from any dispensing or handling equipment or from any area where tanks may be filled and at least 4 feet above the ground level providing there is natural drainage away from the area at which these receptacles are located. In other words, LP gas is heavier than air and will tend to flow along the ground much as water and should the fenced in area be within a diked enclosure, this gas on a windless day might accumulate to a dangerous height; on the other hand, if the area is not diked, the likelihood of an explosive mixture rising to a 4-foot level, 20 feet or more distant from its possible source is most unlikely.—G.R.

Grease Pit Lighting

Q. What kind of fluorescent electrical fixtures (permanent units) are supposed to be used in grease pits of commercial garages?—A.C.L.

A. Section 5131 and 5141a require all wiring and equipment below 4 feet of the main level to com-

ply with the provisions of Class I, Division 2 of Article 500.

Sections 5019b2 to 6, inclusive list the requirements for Class I, Division 2 fixed lighting fixtures. Basically the starting and control equipment would require these units to be of an explosion-proof type.—B.Z.S.

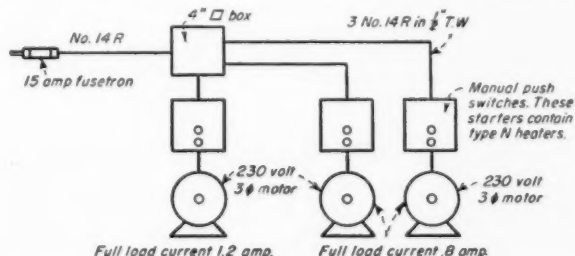
Service Switches

Q. As I recall an enclosed service switch did not have to be externally operable provided the feeders or circuits supplied through it were protected by externally operable switches. Has this been changed? I can't locate same in the Code.—E.D.

A. Section 2356 of the 1951 Code definitely tells us that an enclosed service switch or circuit breaker shall be externally operable. The 1947 edition of the Code did not require such switches to be externally operable provided additional enclosed, externally-operable switches or circuit breakers were provided for control of all individual feeders and circuits supplied through it. In line with the above Code change, your recollection which met the requirements of the 1947 Code is no longer recognized in the 1951 Code.—B.A.McD.

Motor Branch Circuit

Q. I believe there is a Code violation in this motor wiring diagram. Please comment.—P.R.G.



A. According to Section 4343-a of the Code, several motors may be placed on one branch circuit provided the full load current of each motor does not exceed 6 amperes and the branch circuit is protected at not more than 20 amperes at 125 volts or 15 amperes at 600 volts or less. Your sketch shows three, very small three phase, 230 volt motors connected to a 15 ampere branch circuit fused at 15 amperes. In so far as the motors are concerned, I see no Code violation. I note that the control switches are manual and I assume they are within sight of the motor location. Since the motors are not automatically started individual overcurrent protection is not required, but it is good practice to furnish same as shown on your diagram.

I note, however, that you use a 4-inch square box as a junction box for connecting the three individual motor circuit conductors to the branch circuit conductors. If the box you are using is 1½ inches in depth you are only permitted to install 11 No. 14 wires in such a size box according to Section 3709. According to your diagram 12 wires terminate in this box, which is a Code violation. A 4-inch box, less than 1½ inches deep, only accommodates six No. 14 conductors.—B.A.McD.

Overcurrent Device

Q. We have wired a number of the low one story ranch type homes and have found it a good engineering practice to attempt to locate the main distribution panel somewhere

We make NO BONES about it!

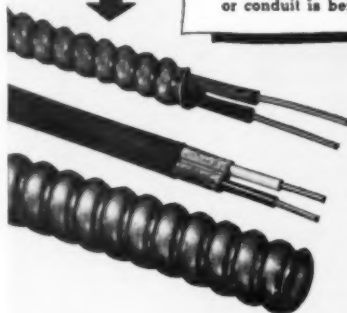
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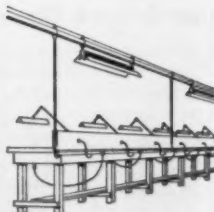
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near the center of the home. This has meant extending the service entrance conductors for a considerable distance through the building or locating the service at the point of entry and then carrying from there feeders to the point of distribution. Because of competition, we would like, if possible, to locate both the service equipment and the distribution panel within a utility room in a certain floor plan which will be approximately 35 feet from the point of entrance of the service conductors. We understand this would comply with the Code if overcurrent protection were provided for the service entrance conductors at their point of entry to the premises. Therefore will the Code permit us to mount cartridge fuse cutout bases at the point of entry and run from that cabinet to the distribution panel and main service in this utility room? —T.F.K.

A. Yes. This could be done provided certain precautions were complied with as Section 2372 of the N. E. Code states that the service overcurrent device shall be an integral part of the service disconnecting means unless located at the outer end of the service raceway, and under Section 2351 we find the requirement that the disconnecting means shall be located at a readily accessible point nearest to the entrance of the conductors, either inside or outside of the building wall. Then under Section 2440 you will note that where cartridge fuses are used for overcurrent protective devices and do not have disconnecting means on the supply side, such fuses shall not be accessible to other than qualified persons. Therefore, where it is desired that service be run for some distance within a building and fuses are used to prevent induced surges from entering the building by being located at the point of entry of the service conductors, such fuses must be enclosed within a sealed cabinet in order that they will be accessible only to qualified persons. Permission to do this is granted under Section 2373, which states that if the service overcurrent devices are locked or sealed, or otherwise not readily accessible, branch circuit overcurrent devices shall be installed on the load side, shall be mounted in an accessible location and shall be of lower rating than the service overcurrent device within the locked or sealed enclosure. I personally believe the best type of installation in these one story basementless homes is to provide the service equipment at the point of entry, preferably in the garage section, if attached, with feeders extending from the service equipment to the one or more points of distribution within the dwelling.—G.R.

Now...

added to the Silvray line of
special-effect lighting units —

THE SILVER-DOT RECESSED DOWNLIGHT



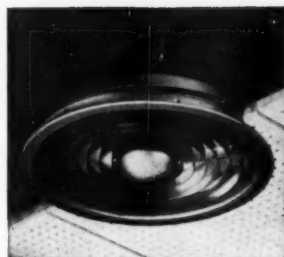
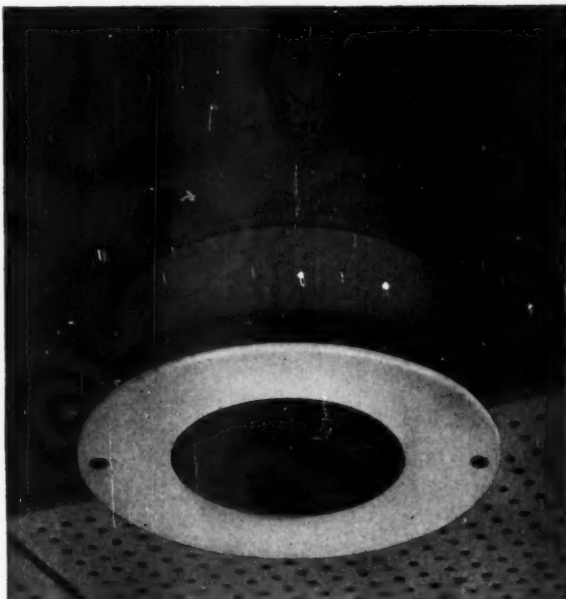
Featuring complete concealment of the light source, this compact Silver-dot unit rounds out Silvray's line of all-purpose incandescent downlights.

Employing a 4" ceiling aperture for passage of a precisely-focused light beam, the Silver-dot is ideally suited for supplementary accent or special-effect lighting in commercial and residential interiors.

Silver-dot units are designed for use with the new 100-watt A-21 clear silvered-bowl lamp. They produce more candle power than equipment using 150-watt reflector or projector lamps...use less energy...generate less heat.

Placed 6' above the surface to be lighted, for example, the Silver-dot casts a 6' glare-free light circle. Relamping, without removing the ceiling plate, restores the unit to initial efficiency.

Easy to install, the Silver-dot requires a ceiling opening only 6½" in diameter...a recess depth of only 7¼".



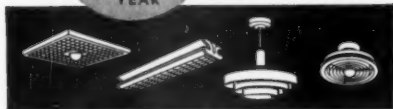
THE SILVER-SPOT

Companion piece to the Silver-dot, this versatile, general-purpose downlight is available for both recessed and surface-mounted installations. 10¼" in diameter, the Silver-spot requires an opening depth of only 5½" for complete recessing...projects only 3½" when surface mounted. Precision light control of built-in reflector eliminates glare and wasted spill light. Louvre provides 45° shielding.



THE SILVER-SPOT ADAPTOR

Designed as a portable unit, this 8" diameter version of the Silver-spot is equipped with a "screw-in" adaptor base to fit standard porcelain receptacles or swivel fittings. Both the Silver-spot and Silver-spot Adaptor unit use the 100-watt A-21 lamp to obtain the warm color quality so much in demand by merchandising experts. Both units are easily convertible to either floodlight or spotlight distribution.



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Insulated Bushings

Statement.—An electrician uses insulated bushings in lieu of metal bushings to protect No. 12 conductors pulled into ½-in. and 1-in. rigid metal conduit. The conduit is secured to the lighting cabinet by a single locknut and the insulating bushing.

Q. Does the last sentence of Section 3736b apply in this case?
S.H.

A. Section 3736b requires the use of insulated bushing whenever ungrounded conductors of No. 4 or larger are installed. If the contractor elects to use these insulated bushings on smaller conductors he may do so. Regardless of where or when he installed insulated bushings, the general requirement of the last sentence must be fulfilled and double locknuts must be installed, one inside and one outside if bushings are constructed wholly of insulating material.—B.Z.S.

Q. Is section 3016 also violated in that the conduit is not so connected to the cabinet as to provide effective electrical continuity?—S.H.

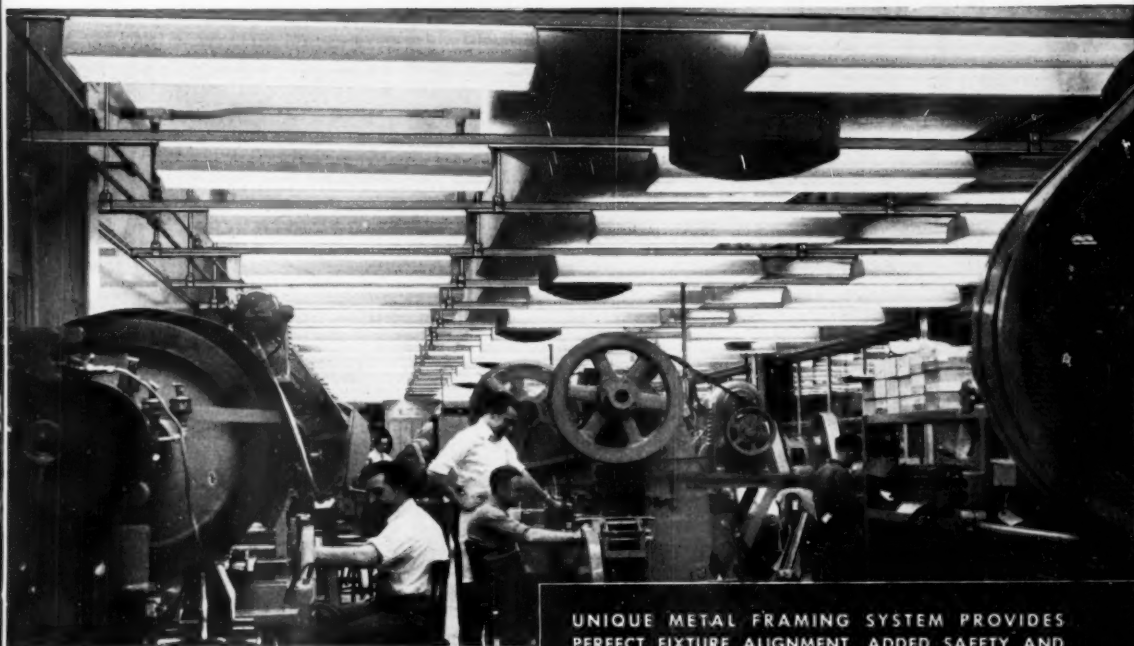
A. Yes. The last sentence of section 3736b is a substantiating statement to this general requirement of section 3016.—B.Z.S.

Cable Runs Continuous

Q. Section 3005 of the Code requires raceways and cable assemblies to be continuous from outlet to outlet. Does this mean that I could not place a junction box in a cable run between outlets? Does it mean that a cable assembly run between switch boxes would not have to be continuous? Does it mean that you could not insert a switch box in a cable assembly run between two outlets?—E.J.N.

A. The wording "continuous from outlet to outlet" has been used in the Code for many years and occasionally has been the source of controversy since the questions you raise appear to be in conflict with this wording. According to the definition of an outlet, a switch box or a junction box would not be considered an outlet. As a result, you could not take current from one outlet and feed it to another outlet through any combination of switches which is common practice today; you could not run a cable, for example, along the wall of a basement, install junction boxes and feed receptacle outlets on the first floor through same; you could not install an outlet in the basement of a residence and run to

ADJUSTABLE **UNISTRUT** CHANNEL, HANGERS and FITTINGS INSTALLED by METALS & CONTROLS CORPORATION to SUSPEND FLUORESCENT FIXTURES



*Planned and executed by G. E. Pieper, Materials Engineer, Spencer Thermostat Division, Metals & Controls Corporation, Attleboro, Mass.

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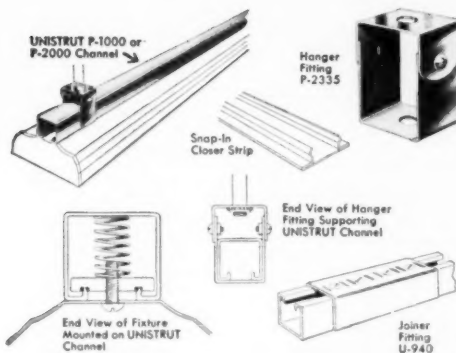


Photo shows rows of 2-lamp 40-watt luminaires supported from overhead "I" beams by UNISTRUT channel, hangers, stems and beam clamps. The versatile UNISTRUT system permitted attachment of supporting stems at any point along the channel length so that luminaires could be spaced at regular intervals without interference from overhead piping or duct, and in spite of varying distances between beams. (Photograph by Metals & Controls Corporation.)

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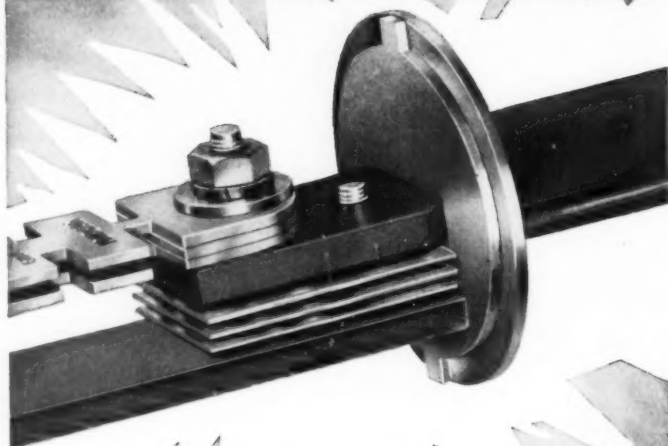
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another outlet anywhere in the building through a junction or switch box. I realize that this interpretation is controversial and the question which you have raised warrants Code clarification.—B.A.McD.

Official N.E.C. Interpretations INTERPRETATION No. 385 (Issued May 20, 1952)

ARTICLE 500—Hospital Hazardous Areas, Seals Where Required

PART I—COMMENT: Within the Class I, Division 1 area of a hospital operating room, it is proposed to install plug receptacle and switch assemblies. These assemblies include an outer enclosure to which conduit connections are made and an inner enclosure containing the receptacle contacts or switch mechanism. Leads from the inner enclosure are brought out through an integral seal into the outer enclosure where they are spliced to circuit conductors. The assembly is approved for Class I hazardous locations.

QUESTION: In conduit connections to the outer enclosure of such an assembly, are seals required to conform to sub-paragraph a-1 of Section 5015?

ANSWER: No. The provisions of sub-paragraph a-2 of Section 5015 shall apply.

PART II—COMMENT: Within the Class I, Division 1 hazardous area in a hospital operating room, runs of conduit are connected to enclosures and extended to less hazardous areas outside of the operating room or above the five-foot level in the room. Some of these runs are buried in the masonry floor slab of the operating room, and some of them are connected to the upper portions of enclosures which are partially below and partially above the five-foot level.

QUESTION 1: Where a conduit run enters a continuous masonry floor slab within a hazardous area and emerges in a less hazardous area, where is the boundary between the two areas in regard to the requirements of sub-paragraph a-3 of Section 5015?

ANSWER: The portion of the floor slab in which the conduit is buried constitutes the boundary, and the buried portion of the conduit run shall be considered to be within the boundary. The seal required by sub-paragraph a-3 may be located in either area.

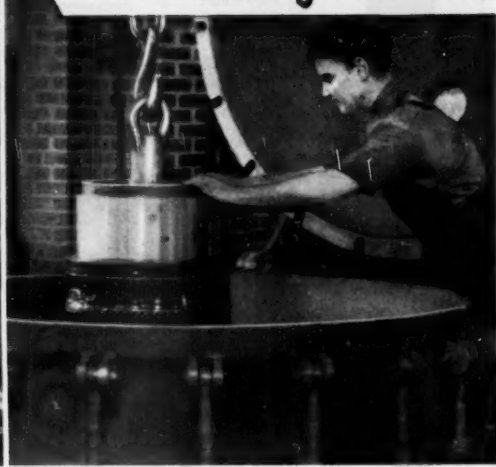
QUESTION 2: Where an enclosure is partially below and partially above the five foot level, and a conduit connection is made to the portion above the five-foot level, where is the boundary between the two levels in regard to the requirements of sub-paragraph a-3 of Section 5015?

ANSWER: The boundary with respect to such conduit connection shall be considered to be at the level of the point of connection, and the seal required by sub-paragraph a-3 shall be located above that level.

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This Universal Adjustable Growler may be used as both an external Growler for armatures and an internal Growler for stators. It will test armatures from 2" diameter up, and stators from 5 1/4" diameter up.



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Motor Shops



GRIPPING TONGS, made in the shop at the Electric Motor Repair Company, are used in conjunction with an overhead chain hoist to provide quick, strong, safe and flexible handling of heavy pieces of equipment.

Gripping Tongs Speed Equipment Handling

Easier movement of motor frames, armatures and other heavy parts and equipment is now provided by a pair of steel gripping tongs, which were made right in the shop at the Electric Motor Service Company, Chester, Pa. These tongs are used in conjunction with the shop's overhead trolley mounted chain hoist, and greatly facilitate such routine movements as from stripping area, to winding benches, to dip tank, to baking oven, etc.

Construction of the tongs is quite simple. Two flat lengths of steel, about 1-inch wide, are bolted together in scissor-like fashion about 10-inches from one end of the pair. At this one end of the tongs, the handles are joined by a short length of chain with a hooking ring at its center. At the other end of the tongs, each blade has a gripping projection which is welded in position to grip when these blade ends come together.

The use of the tongs in this shop has proven a great time saver. Previously, when heavy pieces of equipment had to be moved by chain hoist, it was necessary to loop rope around the pieces, or to somehow wrap and hook the chain around the parts. Because many pieces of equipment were very heavy, it was often a time consuming and trouble-

some task to get sufficient purchase to prevent slips when the piece was lifted. With the tongs, however, these troubles have been eliminated. The tongs are quickly and simply centered on the piece of equipment, and a tight, balanced grip is secured. The chain hoist hook is then brought down and hooked to the ring on the handles-end of the tongs. As the hoist pulls on the ring, the gripping ends of the tongs are tightened on the piece of equipment, and the weight of the piece increases the firmness of the grip.

The crew at Electric Motor Service have also found this handling technique safer and more flexible than the previous use of rope. The tongs can securely hold equipment weighing as much as several hundred pounds, with a gripping strength that self-adjusts to the weight of each load. And the tongs can be used in many places where it is difficult to get at the piece of equipment, such as in a baking oven. The overall simplicity of this method has made it very popular in this shop.

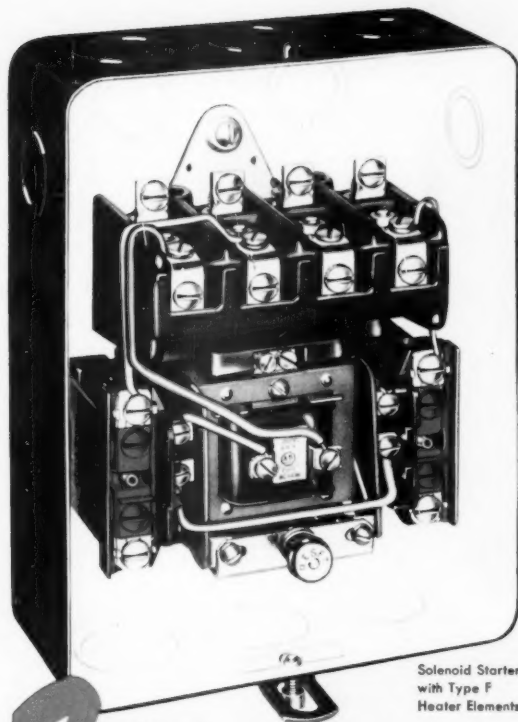
Jig Aids in Measuring Armatures

A special jig has been designed by Albertson & Son in Philadelphia to take the physical dimensions of all armatures when received for rewinding. This information is recorded on a work card so that it can be turned to for checking before returning the completed armature.

The over-all length of the jig is 18



MEASURING small armatures accurately is simplified by special jig designed, made, and used in the shop of Albertson & Son, Philadelphia. Shaft is pushed firmly against stationary end (left). Round cold roll steel piece (right) is pushed against other end and reading taken from metal rule attached to the base.



Solenoid Starter
with Type F
Heater Elements.

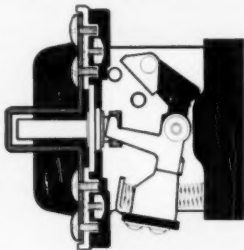
New

SUPER-FAST COMBINATION UNIT

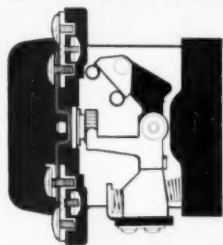
for protecting hermetically sealed motors
used in refrigeration compressor service

THERMAL OVERLOAD RELAY WITH CONVENTIONAL DUAL UNIT

Ordinarily, A-B
overload relays
have a soldered
ratchet spindle
(yellow) that is
separated from
heaterstrip (red).
Heat radiated by
overload heater
melts solder on
spindle and re-
leases ratchet.



THERMAL OVERLOAD RELAY WITH SUPER-FAST COMBINATION UNIT



New, super-fast
element has sol-
dered ratchet
(yellow) brazed
directly on heat-
er strip (red),
permitting quick
transfer of heat
to melt the solder
and thereby re-
lease the ratchet.

Combination Unit for super-fast operation



TYPE F ELEMENT

Soldered ratchet spindle is
brazed to heater for rapid
conduction of heat to solder.

ALLEN-BRADLEY CO.
1316 S. Second St.
Milwaukee 4, Wis.

Most motors used for hermetically sealed compressors are cooled by the refrigerant circulated over the motor windings. They are worked beyond the limit of air-cooled motors, and have little overload reserve.

To give dependable overload protection to these hard-working motors, Allen-Bradley has added the new Type F quick-acting heater element. Its special construction, described above, makes it respond within a few seconds to any overload, and trips the overload relay before motor burnout occurs.

If you need motor controls that are quick-acting in case of overload, specify Type F combination elements for Allen-Bradley solenoid starters.

Dual Unit for average operation



SPINDLE

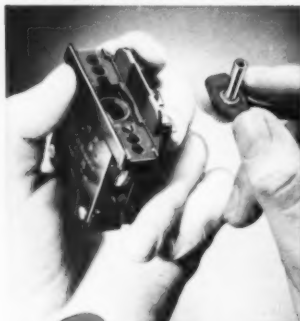


HEATER

ALLEN-BRADLEY
QUALITY
OVERLOAD PROTECTION



Pick the right spindle to fit the starting cycle. Insert the spindle in the A-B thermal overload relay. The relay is ready for the heater element.



It's so easy to provide Starting and Running Protection with Allen-Bradley Thermal Overload Relays

INTERCHANGEABLE RELAY SPINDLES



TAN SPINDLE—for normal allowable locked rotor time and long starting time.

RED SPINDLE—for normal allowable locked rotor time and normal starting time.

GREEN OR GRAY SPINDLE—for low locked rotor current and short allowable locked rotor time.



SUPER-FAST SPINDLE—for low locked rotor current and extremely short locked rotor time.

FIRST—to provide locked rotor protection—pick the overload relay spindle (see pictures at left) that matches the motor characteristics. There is an Allen-Bradley relay spindle to meet every need.

SECOND—to provide running protection—pick the heater element (see pictures at right) to fit motor full-load current. There is an Allen-Bradley heater element for every rating. This two-way protection is standard for all Allen-Bradley solenoid motor controls.

INTERCHANGEABLE HEATER UNITS



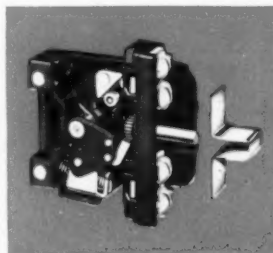
LOW RATING



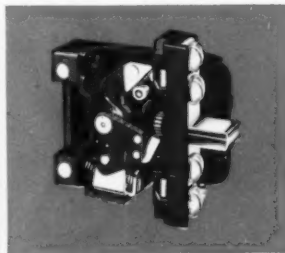
MEDIUM RATING



HIGH RATING



A-B overload relay with heater element detached to show the relay spindle.



A-B overload relay with heater element mounted in place over the relay spindle.

ALL ALLEN-BRADLEY SOLENOID MOTOR CONTROLS HAVE TWO-WAY OVERLOAD PROTECTION



Manual Starter



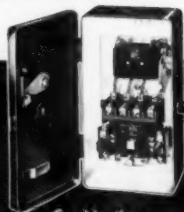
Automatic Starter



Reversing Starter



Multispeed Starter



Combination Starter

5-52-MR



ALLEN-BRADLEY
SOLENOID MOTOR CONTROLS

QUALITY

ALLEN-BRADLEY CO.
1316 S. Second Street
Milwaukee 4, Wis.

inches. It consists of $1\frac{1}{2}$ in. angle set to form a "v" angle. This permits armatures to be set in it and held in place.

A metal rule has been attached to the side of the angle iron. An end bar has been welded onto the end of the angle iron so that the armature shaft is pushed up to it as a stop guide.

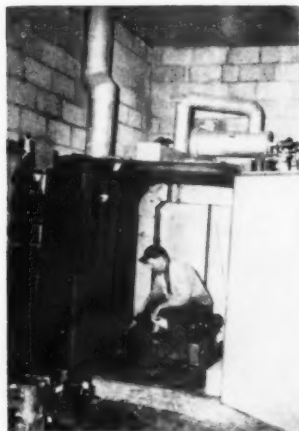
A round piece of 2-in. diameter cold roll steel, about 1-inch thick, is used as the measuring guide at the other end of the armature. This is pushed right up to the end of the armature shaft. Then by dropping the vision to the ruler, the over-all length of the shaft can be easily determined.

Albertson takes a shaft measurement of each armature, a measurement to the distributor from the core to each end of the shaft, measurements of the distributor from the end of the shaft to the edge of the commutator.

These measurements are recorded on a data card so that when the armature is re-assembled, it is exactly the same as when it was first received. This insures all armatures leaving Albertson to be the same as when they were received, as all commutators are removed from the shaft before rewinding.

Walk-In Bake Oven Built In Shop

A highly efficient baking oven was economically constructed in the motor repair shop of the Curio Electric Service, Allentown, Pa. This 6-ft. by 6-ft. by 6-ft. walk-in type baking oven now permits the shop to handle more baking jobs in less time.



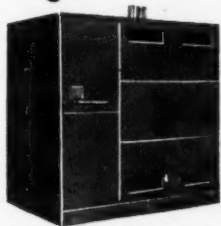
WALK-IN BAKE OVEN at the motor shop of the Curio Electric Service, Allentown, Pa., was built in the shop with steel beams, corrugated iron sheet and rock wool insulation; uses a gas-fired heater.



TYPE C

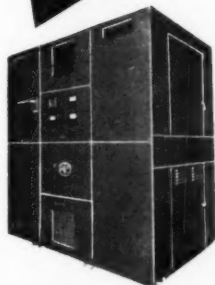
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MARCUS DRY TYPE, AIR-COOLED TRANSFORMERS ARE SAFE — No explosion or fire hazards. No fire proof vaults. Class B and C heat proof insulations.

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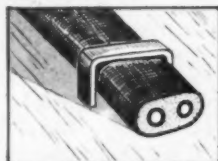
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Special Rex E-Z Drive Staples have round legs for easy driving, and a flat top to prevent staple from biting into insulation.



Rex line always "up to the minute" in latest developments. For example, this T-Type Staple was on the market within a very short time after the introduction of T-Type cable!



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TITCHENER CABLE **REX** STAPLES "The Complete Line"



ROMEX
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EXTRA-HEAVY BX
Item 206



T-TYPE
Item 201



E-Z DRIVE ROMEX
Item 203



REGULAR BX
Item 204

(Above pictures are all Full Scale)

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The oven is constructed of steel beams, covered with corrugated iron sheet and insulated with rock wool insulation. A gas-fired heater is attached to the roof of the oven and is provided with a system of ducts for circulating the heated air through the oven. From this heater, one duct carries the heated air to the base of both sides of the oven where it is released through openings into the oven. In the center of the oven top, is another duct through which the heated air in the oven escapes. Half of the escaping air is fed back to the gas heater ducts where it is reheated and returned to the oven. The other half of the air is carried outside through an exhaust duct.

Efficient operation of the oven attests to its well-engineered construction. In use, a temperature of 230 degrees F. can be raised within 12 minutes after the gas fired heater has been started. A timer is attached to the oven and is set for six hour periods. Prior to the construction of this oven, the time required for baking was about double what it is now.

The system of circulating ducts used on this oven has several notable advantages. The return of half of the air in the oven to the heater provides a steady operating temperature of about 270 degrees F. This results from the quick heating of the already pre-heated air which requires very little reheating in the heater to be raised to operating temperatures for return to the oven. The use of the outside exhaust duct prevents recapture of all of the heated air, thereby eliminating moisture which is driven from the re-wind job being baked. These and the other features combine to make this inexpensive oven a highly effective unit.



ELECTRONIC CONTROL equipment is explained to Selden F. High (left), Sullivan Electric Co., Cincinnati; and W. G. Brush (right), Electric Motor Service, Inc., Birmingham; by H. W. Barker, Cutler-Hammer Co. representative in Chicago.

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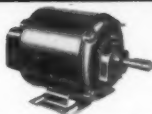
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When you select a motor from Wagner's complete line, you get a motor that is completely dependable in its specific application. You can choose from a wide variety of types and sizes. Here are a few of the motors in the Wagner line. At right is TYPE RP—open type polyphase squirrel-cage motor. It is drip-proof and suitable for all general purpose applications. 1/6 to 400 hp.



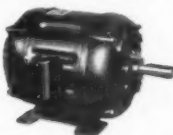
SINGLE-PHASE



TYPE RB—Split-phase Induction. For easy starting applications with high starting current. 1/20 to 1/2 hp.



TYPE RK—Capacitor-Start Induction. For general purpose applications requiring high starting torque—normal starting current. 1/6 to 3 hp.

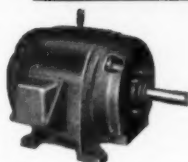


TYPE RG—Repulsion-Induction. For high starting torque applications involving a very long starting period. 1 to 5 hp.



TYPE BA—Repulsion-Start Induction. For general purpose applications with high starting torque—low starting current. 1/2 to 15 hp.

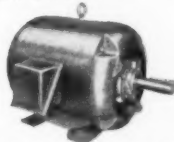
POLYPHASE MOTORS



TYPE XP—Splashproof. Protected against splashing or dripping liquids. 1/4 to 200 hp.



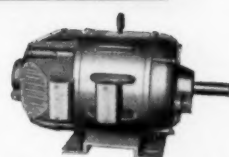
TYPE TP—Totally enclosed, non-ventilated. Fully protected. 1/4 to 15 hp.



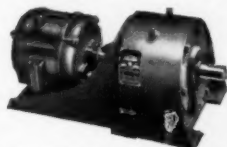
TYPE CP—Totally Enclosed Fan-Cooled. Protected against dirt, chips, abrasives or fumes. Steel frame. 1 to 250 hp. Also in explosion proof type HP.



TYPE EP—Corrosion-resistant Totally Enclosed Fan-Cooled. Cast iron frame. 2 to 250 hp. Also available in explosion proof type JP.



TYPE RS-1—Wound Rotor. Constant or adjustable varying speed. 1 to 250 hp. TYPE RS-2 for intermittent service. 2 to 200 hp.



GEAR MOTORS—Single-phase or Polyphase. Open or enclosed types. 1/20 to 50 hp.



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(14) Rigid Conduit Installation Hints Broadside #18-90—twenty illustrated tips on installing rigid conduit.



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Reader's Quiz

Meter Readings

QUESTION V20: Here is a question that has caused us and utility a headache. We received a garage three years ago, divided it up according to the code and connected it to a 4 wire 3 phase service. The utility has a rate for installations of this kind using lights, power, and some forms of heat on the 4 wire meter. This job worked fine when it was noticed that the meter reading was not in line with what it should have been. In December the reading was definitely behind what it had been in October. The utility changed the meter. When the trouble was still present they called us in to check the building. We found that one circuit consisting of a stoker motor and 2 unit heaters would cause the meter to run in reverse, any one of these motors has the same effect. These units all check perfect, so we then switched this circuit on to the other leg and the meter ran OK. We then connected the balance of the heating plant consisting of two unit heaters to the leg that the first circuit was connected to and the same old trouble immediately showed up.

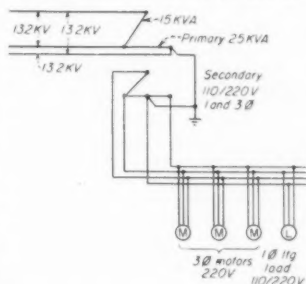
The service is fed from an open delta transformer, with the neutral carried solid from the transformer to the service equipment and on to these motors. The transformer is grounded and the service is grounded and the drop from the transformer is about 50 feet from the building.—G.F.P.

ANSWER TO V20: There are several questions I would like to ask about the problem, but I do know this much about it, even from your brief description: Open delta does not furnish a normal current, and has sometimes very complicated harmonic voltages as well as currents, and when you add this connection to a 4 wire service and try to get accurate meter readings on a single meter, even if it is a "4 wire meter," complications are invited. If it is permissible by the utility, have them add another transformer to the bank to help take care of these floating currents and dangerous harmonic voltages; that gives them a chance to flow around the complete "loop" of the delta, instead of sending their high frequency potentials inside the building. Also as a test, try disconnecting the ground at the service entrance and

see if the "leg" you mentioned still causes the meter to run backwards. At the same time, give the complete heating plant an insulation resistance test. If the primary circuit has one wire grounded like REA systems, that can add to the complications especially if the soil is somewhat dry. If the utility will permit, have a separate meter for the 3 wire 2 voltage lead of lighting and small motors.—M.C.T.

Transformers

QUESTION W20: When transformers are connected "open" delta to an REA 13.2 kv line with one "hot" leg grounded as shown in the accompanying diagram, why should the three phase motors (5 of them) have different currents in each of the three motor leads. This occurs on any one



motor, or all motors, whether or not the single phase lighting load is connected. The currents vary 20 to 40% above the normal full load motor current. The voltages phase to phase are approximately equal at the motor starters or terminals. The five three phase motors were manufactured by three different well known manufacturers.—W.L.T.

ANSWER TO W20: With the primary and secondary windings interconnected as shown on the sketch, the voltage in AB phase of the primary will be opposed by the induced voltage from B' to X of the secondary winding. In other words, B'X of the secondary is directly bucking the primary voltage of phase AB. There is an inherently lower voltage across the "open" phase of an open delta connection. One cause for this is that the voltage induced across the "open"

phase of the secondary undergoes an impedance drop as it must pass through the impedance of the other two phases.

An improvement in secondary voltage of phase A' B' will be obtained if the interconnecting (primary to secondary) jumper is removed from the primary side. If it is necessary to ground the primary winding, the best connection will be to phase C in this particular case. A ground connection at this point will tend to unbalance the secondary voltages, but not so much as with the connection as it is now. A check of the voltages should be made with no motors connected in the circuit. The motors, when connected, will tend to equalize the secondary voltages.—W.F.N.

ANSWER—TO W20: The open delta on V connection is an unsymmetrical connection which is used if one transformer of a bank of three single-phase delta-connected units must be cut out because of failure. It is a connection that is resorted to as an emergency expedient, or as a temporary measure with the intention of completing the delta when the condition of the third unit is warranted by the load. If one phase of a three phase core type transformer is damaged, the operation may be continued by leaving the damaged phase open-circuited, provided the windings are still capable of withstanding the voltage stresses. Since full line currents flow in the windings out of phase with the transformer voltages, the normal capacity of the open delta bank is reduced to 57.7% of its delta rating. Service may be given from two transformers to three-phase power users by the open-delta connection thus reducing the investment in transformers for the smaller user. The open-delta connection from a three wire system is the usual delta connection with one transformer omitted. The current in each of the two single-phase transformers connected in open-delta is 73% greater than the current in each of the three transformers connected in closed-delta, assuming the same three-phase load is applied.—O.C.

Zero Adjuster

QUESTION X20: Why can a zero adjuster be used on ac voltmeters and ammeters when we know that these



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meters cannot be read near the zero mark?—H.S.

ANSWER TO X20: It is characteristic of ac instruments of the dynamometer type to have scales that are crowded and inaccurate on the zero end and having maximum spread of graduations at center scale. So the "zero adjuster" should be used as a means to correct for inaccuracies that might occur in the more desirable part of the scale. This of course must be done in conjunction with other instruments of known accuracy.—E.G.

ANSWER TO X20: The zero adjustment is necessary on all instruments of that type to adjust the tension on the hair-spring. The instrument was originally calibrated with the pointer rested on zero and readings should only be taken when the pointer is on 0 otherwise they will not be accurate. Changes in temperature and a possible change of the adjustment may cause the pointer to move slightly off 0 in which case it must be returned to 0 before readings are taken.—A.E.T.

Substation Ground

QUESTION Y20: *What is the easiest method of determining if a substation ground for lightning arrestors and transformer tanks is satisfactory?*—D.H.N.

ANSWER TO Y20: There are at least four points to check to determine if a ground is satisfactory. (1) Resistance between grounding electrode and ground. (2) Resistance of grounding bus between equipment and electrode. (3) Impedance of grounding bus. (4) Directness of grounding path. A short direct path is desirable so that fault or lightning current will not jump to building or other equipment. An article on grounding appeared in the April issue of this magazine and included information on equipment grounds.—R.J.S.

ANSWER TO Y20: If the substation is at all elevated there may not be an easy or simple way of testing the condition of the grounding system. Certain systems for small installations have adopted a practice of connecting the ungrounded conductor of a separate adjacent system to a ground point through a fuse usually of the order of 5 amperes. If the fuse does not blow steps are taken to improve the ground. Under many conditions lowering of ground resistance may involve expense and labor. Supplementing the foregoing an ammeter of the clip on or split core type may be in-

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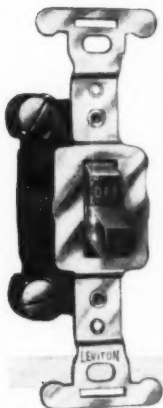
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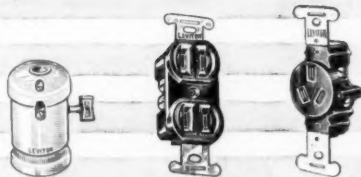


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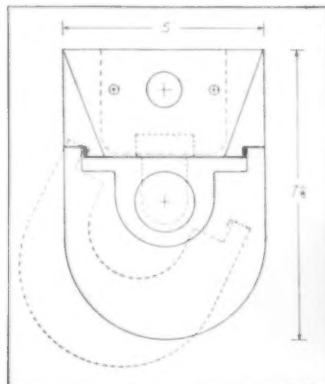
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ing the test to get an actual current
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current adjustments. The 5-ampere
value given before is approximately
the result one can obtain for the aver-
age lighting circuit and a ground re-
sistance of about 250 ohms. With
expensive valuable equipment to be
protected the cost of a ground tester
becomes relatively insignificant and is
a worthwhile expenditure. There are
a number of inexpensive testers avail-
able which can be operated with a
minimum of instruction. What the
value of station ground resistance
should be cannot be definitely stated
but the value of 25 ohms previously re-
ferred to is a maximum found to be sat-
isfactory for single transformer groups.
In practice there are usually at least
four ground points for each station
and these may have to be added to
or supplemented if the resistance is not
low enough. A value of less than 10
ohms is a not unusual one as a maxi-
mum and even lower values are rec-
ommended.—C.O.D.

Signalling

QUESTION Z20: As long as a cer-
tain switch is closed in our plant I
want to get a series of strokes on a
single stroke bell. This is to dis-
tinguish the signal from ordinary bells.
Auxiliary contacts are available for
closing a signal circuit. Can this be
accomplished using only one relay and
without any rotating coding device?
—P.S.

ANSWER TO Z20: I would suggest
measuring the current the single stroke
bell takes. Then get a time delay over-
load relay (automatic resetting type)
which will operate on the current
measured. Then it will only be neces-
sary to adjust the relay operating time
so as to allow the bell to make one
stroke. It will then operate and reset
and repeat the cycle. An oil dashpot
or bellows type overload relay with
circuit opening contacts can be used.
A simple and inexpensive method is
to connect a thermostatic flasher in
series with the single stroke bell. The
flasher is very easily obtainable. It is
the type used for signs and displays.
It will turn the bell off and on at in-
tervals. It is an interval operating
relay. They are usually made for use
on about 115 volts and about 60 watts
and therefore will only be OK if your
bell is about 115 volts and about 60
watts. Other voltage and watt ratings
are usually more difficult to purchase.
—E.B.

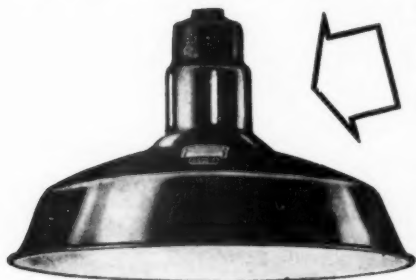
ANSWER TO Z20: A slow release
relay can be used for this purpose.

ANOTHER ABOLITE FIRST!

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REFLECTOR**

VENTILATION

definitely increases light efficiency!



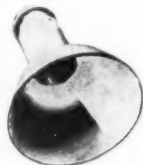
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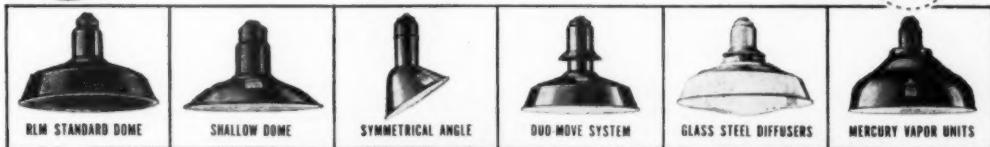
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Can you ANSWER these QUESTIONS?

QUESTION P21—We have a 300-hp, 230-volt dc motor driving a super calendar. It's about three years old. Recently it started to chatter and the commutator seemed to get quite hot and colored. The brushes were originally furnished by the manufacturer of the motor. The mica is well undercut. The commutator seems to be in very good shape. I have stoned it, sanded it, and have set the brush pressure with scales, but I have been unable to stop this chatter. Could someone tell me what I could do to stop it?—A.T.

QUESTION Q21—We have a transformer. The nameplate reads as follows: "Size 333 kva, voltage on high side 2400/4160Y, voltage on low side 240 x 480. Impedance 4.75% at rated volts, 75° Centigrade. With 2-2½ percent taps above and below normal voltage."

Does this mean that the impedance of 4.75% is correct regardless of what voltage tap is being used?—M.D.

QUESTION R21—Will someone please give a clear explanation of how to go about getting an accurate test and computation of the kilowatts in a 3 phase 3 wire balanced circuit with a single-phase hook-on type of kilowatt meter.—J.M.M.

PLEASE SEND IN
YOUR ANSWER BY AUGUST 15



Cat. No. 385



Cat. No. 385-W

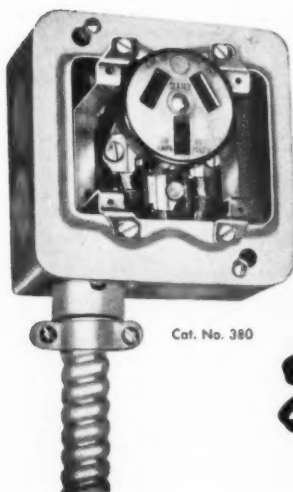
at home on the range

Slater SURFACE POWER OUTLETS

... ideal for all electric range and industrial applications — the Slater 385 series. Rated 50 amps @ 250 volts, from cover to contacts they're designed to suit the *particular* job and make installation easy.

MODELS: Standard black (No. 385), and the sure-selling Custom-Kitchen White (No. 385-W) for smart appearance before or after range installation.

It's the neatest, most durable and versatile surface power outlet on the market!



Cat. No. 380

- Elevator-type terminals ride up or down with screw — elevated, ready to take #6 stranded wire for fast wiring-up.
- Quick cable clamp for either back or bottom mounting — holds any size cable permanently in place.
- Wide open work space for fast wiring-up.
- Extra-tough and springy phosphor bronze terminals for maximum contact and grip.
- Triple knockouts on back and bottom for easy mounting of any cable connection.
- Choose the knockout that fits — the rest won't come out.

Also available in flush-mounted design (No. 380) with heavy-gauge plate. Interchangeable with all specification grade receptacles and plates.

Approved by Underwriters' Laboratories

Slater ELECTRIC & MFG. CO., INC.
56th Street and 37th Avenue
Woodside, New York

Once upon a time
fluorescent tubes
averaged
only 2500 hours.



But then came Sylvania and improved all that by making a tube that averages 7500 hours.

In addition, Sylvania now guarantees to return your money if you're not entirely satisfied.

To you industrial buyers, this new and shining light means improved production plus lower maintenance costs. If you want to know how much you can save, mail the coupon and I'll show you how to figure it.

Yours for better lighting,



Chuck Burton

General Sales Manager, Lighting Division

Sylvania Electric Products Inc.
Dept. L-276B, 1740 Broadway
New York 19, New York

I'd like to know more about Sylvania Tubes' better performance and bigger savings. Please send me a copy of "How to get the most from your Lighting Dollars." (FL-408)

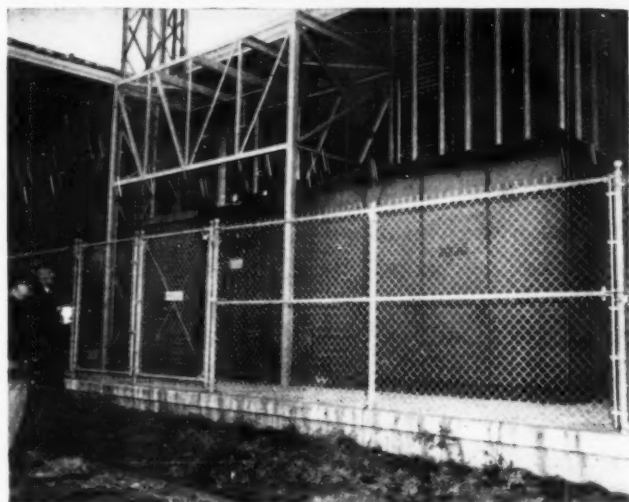
Name _____

Company _____

Address _____

City _____ Zone _____ State _____

Practical Methods



LOAD CENTER SUBSTATION, above, is one of five such units located in the Highland Cotton Mill, High Point, N. C. The units have eliminated a serious system overload, effected appreciable maintenance savings and increased system capacity for higher production.

Load Center Subs Raise Power Capacity

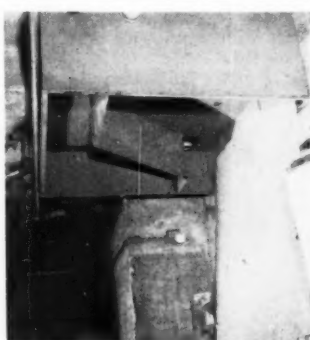
CONSTRUCTION

An installation of five load center substations has corrected severe electrical system overload and increased production at the Highland Cotton Mill, High Point, North Carolina. Prior to this installation, progressive increases in the electrical load at the mill had brought maintenance of motors and lighting equipment to a serious impasse.

Before the new, larger General Electric power units were installed, the electrical system in the mill operated from three 750 kva transformers which were heavily overloaded. This overload and relatively long cable runs to many of the motors in the mill resulted in excessive low voltage at the motors, causing serious overheating. Attempts were made to maintain proper motor voltage by using higher voltage taps on the transformers. This step, however, caused high voltage during light load periods and also resulted in excessive lamp burn-outs.

To correct the situation which had developed, four 1,500 kva and one 750 kva load center unit substations were installed in the mill. The various units were carefully located to obtain minimum length of cable to the loads.

The results of this installation were immediately satisfactory. Voltage was stabilized, and savings of approximately 25% on motor maintenance and 20% on lamp replacement were effected. In addition, the present power capacity of the system will allow the anticipated further increases in mill load to raise production by over 40%.



PLENTY OF ROOM for handling 4,800-volt, single-conductor, Neoprene Coronol shielded primary distribution cables is feature of this large pull box in basement of Bullock's Los Angeles store. Unit installed by the R. R. Jones Electric Co., has metal partition separating the dual primary feeders (six 4/0 cables in two 3-in. conduits) which start up shaft at this point.

VERSATILE LIGHTING-JOB TAILORED

STEBERLITES - USE THEM SINGLY OR IN CLUSTERS



Steberlite Lamp Holder S-300 for medium base Par-38 and R-40 lamps. S-350 for Mogul base R-40 lamps.

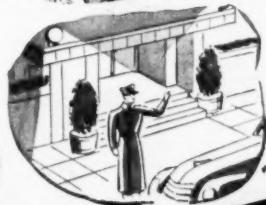


All Steberlites listed by Underwriters' Laboratories, Inc.

Complete, compact, weatherproof Lamp Holders that save labor and wiring costs. Mounted singly or in clusters up to 5 they provide for general or supplementary spot and floodlighting for used car lots, parking lots, service stations, building entrances, displays, and around farms, homes, parks, lawns, flower gardens, etc.

A small inventory of Steberlite basic units does a big sales and profit job. If a copy of Bulletin 120-50 is not at hand, write today.

By use of Adapter Box S-301, clusters up to 5 can be assembled as one unit and fitted to 1 1/2" or 2" pipe or for connection to conduit.



STEBER UTILITES

For Par-38 and R-40 Reflector Sealed Beam Lamps
Listed by Underwriters' Laboratories, Inc.

Nearly four million Steber Utilites have been installed—good evidence of the tremendous market for these all-round Lamp Holders.

No. 2 is for indoor or outdoor service, with U bracket for universal adjustment and round base for surface mounting or for outlet box mounting. Free Point of Sale 3-color display stand in every standard package. Utilites are a complete line of Lamp Holders, including swivel units and color equipment.



No. 2 Utilite for spot of floodlighting, indoors or out.



No. 8 Swivel Utilite.



No. 7 Swivel Utilite, heavy base has protective rubber bumpers—also mounting holes.

STEBER

FLOODLIGHTS

Fast Moving Types and Sizes That Meet 90% of All Needs

In addition to the wide use of Steber Floodlights around industrial and commercial areas, parking lots, shipping areas, etc., Steber Floodlights are being more widely used around homes for greater outdoor living as well as for protection. Open types No. 57 and 59 (100-300 watts) and enclosed types No. 572 and 592 (100-200 watts) are particularly suited.

For larger areas the No. 1600 enclosed type with spun aluminum reflector provides high intensity lighting for billboards, outdoor displays, etc. Uses 300-500 watt Mogul base lamps.

For Sports Lighting the newly introduced 4000 Series is available. These are enclosed types with all standard mounting brackets. Write for Bulletin 128-50.

All Steber Floodlights are listed by Underwriters' Laboratories, Inc.



Series 57



Series 1600



Series 4000

STEBER MANUFACTURING CO.

Dept. 99,
Broadview (Maywood P. O.), Illinois

New Products

Within the past year The Adalet Manufacturing Company of Cleveland has introduced a new series of cable supports, the "Wedgelocks", and a new bus-drop cable clamp, the "Sky-Tie".

THE "WEDGELOCK" SERIES

of cable supports has been developed from a basic fitting, each of the series doing a different type of operation involving the supporting or gripping of cables.

The dual-purpose support and seal combination fitting is shown. This fitting not only supports the cables but is compound filled to prevent water following down the cables into the conduits.

Wedge inserts are of "Sali", a laminated phenolic of extremely high strength, tapered to lock more tightly as strain increases.



THE "SKY-TIE"



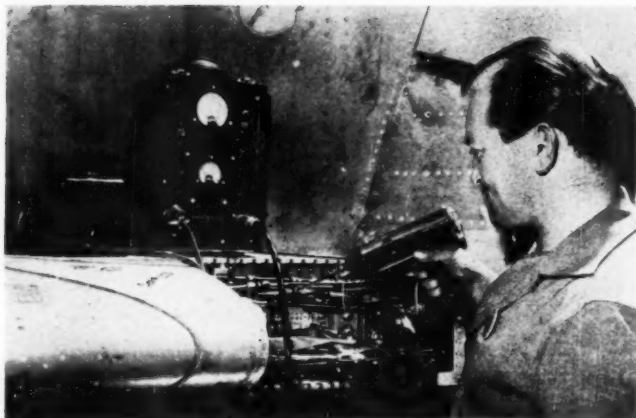
from bus duct. This method permits quick installation and ready rearrangement of machines.

Most important of electrical fittings for such installations is a clamp for suspending cables above machines. It is also necessary to anchor the cables at the busway and machine. All of these requirements are met by the "Sky-Tie". Installation is merely a matter of tightening two bolts with clamp in position.

Ask for Bulletin G-4-52 which describes both these fittings. A request to the manufacturer will also put your name on their list to receive announcements of new products.



CLEVELAND 11
OHIO



LEAK DETECTOR which is sensitive to halogens is used to locate any leakage of halogen which has been injected into the empty fuel system prior to its installation in an airplane at North American Aviation, Inc.

Leak Detector Checks Fuel Systems

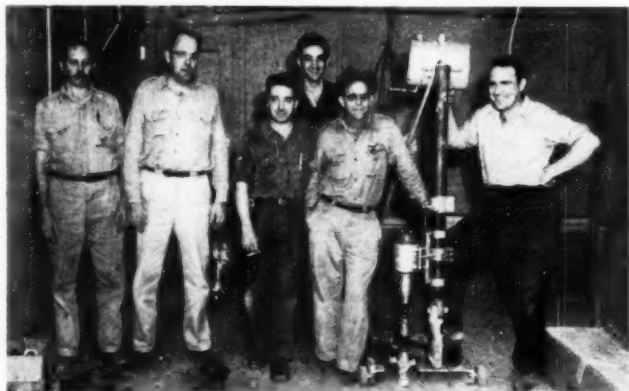
PRODUCTION

A portable, pistol-like leak detector now offers quick and sensitive detection of leaks in aircraft fuel cells at the Los Angeles, Calif., plant of North American Aviation, Inc. This device, originally developed by the General Electric Company to test for leaks of refrigeration systems, is capable of detecting openings so small that only 1/100 of an ounce of air would escape in a year.

The operating principle of the de-

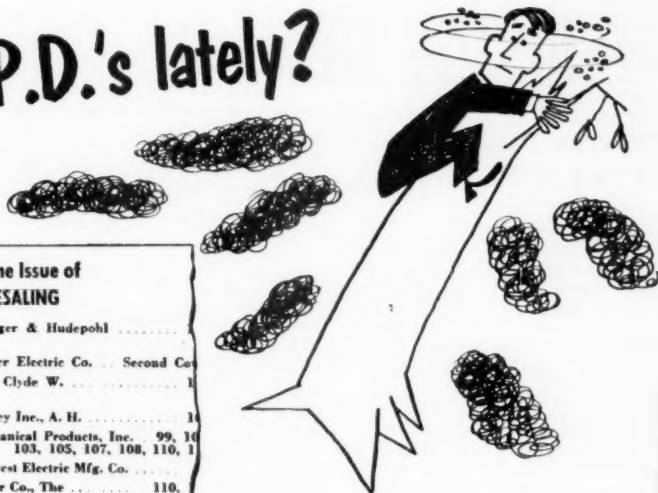
tor is based on its sensitivity to halogens. At North American, a small amount of halogen is injected into the empty fuel system prior to its installation in the aircraft. Then with a pressure maintained in the fuel system, the sensitive end of the pistol-detector is run over the fuel system, checking all possible points of leakage. The detector is used to locate leaks in the bag, vent, entrance, flow fitting and attach lines of self sealing and bladder-type fuel cells.

Nine of these detection devices are now in use at North American and have greatly reduced the time required to locate leaks.



DIAMOND CORE DRILL was used by The Howard P. Foley Co., electrical contractors, Pittsburgh, Pa., to cut through concrete slab to reach cells of Q-floor construction in a new 41-story office building. Mechanics crowd around drill stand made for job. Core drill is mounted to heavy-duty electric drill supported by special movable bracket on upright. Water tank with gravity feed hose furnishes coolant for drilling. Complete unit is on steel plate platform with casters. Mechanic applies downward pressure on drill support during cutting operation. Time required to cut three 2-inch holes in a 3-inch slab, including moving machine, was about one hour. After slab was cut, conventional hole saw was used to go through the steel floor cell.

stumped by P.D.'s lately?



Advertising in the June Issue of ELECTRICAL WHOLESALING

Arme Electric Corp.	8	Kruger & Hudepohl
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Bulldog Electric Prod. Co.	25	Pittsburgh Standard Conduit Co.
Bussmann Mfg. Co.	Fourth Cover	Plymouth Rubber Co., Inc.	Third C
Certified Ballast Mfrs.	30	Porcelain Products, Inc.
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tenance	tional Supply Co.)
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Great Western Fuse Division Tite-	Triangle Conduit & Cable Co.,
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Hazard Ins. Wire Works Div.	112	Electric Co.
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I-T-E Circuit Breaker Co.	12, 13	Van Cleef Bros., Inc.
Jackson Electrical Co.	104	Vulcan Electric Co.
Jefferson Electric Co.	96	Weaver Co., J. A.
Kahn Elec. Sales Co., Harry J.	110	Western Ins. Wire Co.
Keystone Mfg. Co.	105		
Killark Electric Mfg. Co.	15		

How many times have you found yourself in a P.D. (product dilemma)? One of those all-too-frequent situations where the choice of products was wide and the differences narrow. Intent on getting the best for your customer (and most for your money), you phoned your wholesaler's salesman and made him a partner in the problem. He asked a few questions—came up with the right answer. And reassured, you said to yourself "That boy really has the inside track."

Having the inside track on the products you use is a basic responsibility of every alert wholesaler's salesman. And because he is in daily contact with your product dilemmas—from Arrowsic, Maine, to Yucaipa, California—he carefully reviews the advertising pages in **ELECTRICAL WHOLESALING** for product information that ultimately helps you run a more efficient and profitable business.

These are the manufacturers who advertised to your wholesaler's salesman in the June issue of **ELECTRICAL WHOLESALING**. They recognize the value of his service to you and the urgent need for keeping him regularly informed.

**Alert electrical wholesalers
and their salesmen read**

ELECTRICAL WHOLESALING

A McGraw-Hill Publication
330 West 42nd Street, New York 36, N.Y.

THE NATIONAL MAGAZINE OF ELECTRICAL WHOLESALE DISTRIBUTION

In The News

McGraw Cooperation Award to Schuchert

Joseph S. Schuchert, manager of the Commercial Sales Department of the Duquesne Light Company, Pittsburgh, received the Medal for Cooperation, James H. McGraw Award for Electrical Men, at a dinner in his honor sponsored by the Electric League of Western Pennsylvania, at the Duquesne Club in Pittsburgh on June 30th.

Mr. Schuchert received the Award in recognition of his constructive contribution to the advancement of cooperation in the electrical industry through his dynamic leadership in initiating and developing the nationwide Planned Lighting Program. The Award was presented by Curtis W. McGraw, president, McGraw-Hill Publishing Company, acting for the Committee of Awards. The citation read as follows:

"Joseph S. Schuchert, Manager of the Commercial Sales Department of the Duquesne Light Company; recognizing the opportunity and challenge of an all-industry approach to the application of modern lighting principles and equipments to the public benefit and the progress of the electrical industry; through creative development, personal initiative, and persistence, far beyond the normal needs and scope of his commercial responsibilities; built, fostered and inspired an industry-wide Planned Lighting Program.

"With exceptional vision and foresight he introduced and directed to the attention of industry leaders a new concept of Planned Lighting as a theme for coordinated effort by every element of the industry. Through outstanding committee work, speeches and published articles, he successfully enlisted the cooperation and support of industry leaders, trade associations and the business press in all branches of the electrical industry. His pioneer efforts eventually resulted in the nationwide Planned Lighting Program, sponsored by the Edison Electric Institute and recognized by utilities, contractors, distributors and manufacturers as a highly successful concept and method for the promotion and development of commercial lighting and a constructive service to the advancement of the electrical industry.

"Planned Lighting promotion carried out by his own company under his direction proved a model for the industry. An aggressive cooperative light-



JOSEPH S. SCHUCHERT

ing program is a permanent part of the company's operation. As Chairman of the Commercial Sales Section of E.E.I., he directed the preparation of effective sales tools for use in approaching the commercial lighting market. As Chairman of the Commercial and Industrial Lighting Committee, Better Light-Better Sight Bureau, he guided the preparation of educational materials for use in the office, school and industrial lighting markets.

"For his distinguished and outstanding contributions to the cooperation and progress of the electrical industry, the Committee of Awards acting upon the recommendation of the Committee of Judges, presents to Joseph S. Schuchert the Cooperation Medal and Purse for 1951 given under the James H. McGraw Award for Electrical Men."

The panel of Judges who recommended Mr. Schuchert for this honor consisted of: Herbert Metz, Graybar Electric Co., New York, N. Y.; S. R. Naysmith, The Miller Co., Meriden, Conn.; H. C. Thuerk, New Jersey Power and Light Co., Dover, N. J.; and Edward J. White, Edward J. White Co., electrical contractors, Newark, N. J.

Twenty-six years ago the late James H. McGraw, founder of the McGraw-Hill Publishing Company, Inc.; established a series of four awards to encourage constructive thinking for the advancement of the electrical industry. These awards, consisting of a bronze medal and a purse of one hundred dollars, are given for personal contributions of merit in the manufacturing, contracting and distribution branches of the electrical industry and for cooperation within the industry.

BRAB Report on Materials Conservation

The Building Research Advisory Board has completed its one-year study of materials conservation in buildings, and submitted its report. The study was sponsored by James W. Follin's Subcommittee on Construction, Conservation Division of the Defense Production Authority.

The report is in three parts, consisting of 1) a 23-page summary of the findings of the Board and its seven advisory panels; 2) 107 pages of reports by the advisory panels; and 3) an appendix that lists the 300 advisers and gives samples of data from the survey of government practices.

BRAB offers general recommendations in this report, which is directed primarily to the overall problem of how best to use materials in permanent buildings. Of secondary consideration in the survey was the problem of how to save short materials in a defense emergency.

With the consent of DPA's Construction Committee, BRAB at the outset narrowed the job to fit the time and funds allowed. The contract of a year ago called for a bigger order than William H. Schieck, BRAB's Executive Director, and the 300 aides and advisers who helped him, could deliver within the time and money limits. DPA's contract asked BRAB: 1) to collect information that would help evaluate conservation measures in building design and construction, and 2) to review practices in Federal building and construction, including military construction.

Schieck and his colleagues telescoped this two-part order into a single package. First they limited the study to permanent buildings—designed for 25-year useful life or longer. Second, they narrowed it down to types of buildings that are constructed by every one of the five Government agencies they interviewed.

There are five types of buildings in this selected list: office buildings, warehouses, garages, dormitories (or barracks) and hospitals. Buildings of these types are built by the Air Force, Army, Navy, General Services Administration (Public Buildings Service) and Veterans Administration.

Findings of the study rest on a solid premise of long-range economy for buildings. Thus, the Board's recommendation No. 1 states that long-term conservation in a permanent building



Wakefield
CEILING

**THE EQUITY SAVINGS AND
LOAN COMPANY**
Cleveland, Ohio

LICENSED INSTALLER:
The Parker Electric Company
Cleveland, Ohio

LICENSED AGENT:
The General Electric
Supply Corporation
Cleveland, Ohio

ARCHITECTS:
Dalton-Dalton, Associates; Engineers,
Cleveland, Ohio

This Wakefield "Three-way" Ceiling Was a "One-Package" Installation Job

An electrical contractor handled this beautiful Wakefield Ceiling installation from beginning to end. And the job was simplicity itself, since the whole system—including structural, electrical, light diffusing, air diffusing and acoustical elements—was delivered as a single "package".

Not only in banks and stores, but in offices, drafting rooms, model rooms, display rooms, laboratories—wherever optimum audio-visual-air diffusing conditions are requirements—Wakefield Ceilings are being installed with ease.

The installer works with completely standardized parts, guided by installation drawings and parts lists prepared by Wakefield engineers from architects' or engineers' plans and specifications.

The Wakefield Ceiling is a revolutionary development in environment control. It is also revolutionary in its "one-package" installation character. For a detailed, illustrated book on the Wakefield Ceiling, complete with working drawings, write to The F. W. Wakefield Brass Company, Vermilion, Ohio.



Simple, well-planned installation



1. MOUNT "package" of mogul channel plus two regular channels.



2. CUT strips on first regular channel.



3. REVERSE regular channel and uncross spacer rods.



4. MOUNT a regular channel and secure spacer rods.

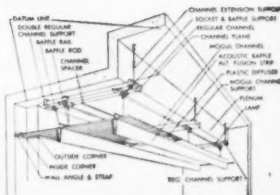


5. REPEAT for other regular channel and install lamps.

All wiring within channels is done at the factory. Then channel units are "folded" for shipment.

This series shows the simple channel mounting system.

When channels are mounted, the entire system of acoustical baffles and supports for the diffuser simply hooks on to them.



Wakefield Over-ALL Lighting



THE GRENADE



THE PACEMAKER



THE COMMODORE



THE STAR



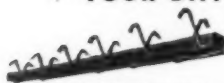
THE WAKEFIELD CEILING

TRUSCON PRESSED STEEL INSERTS

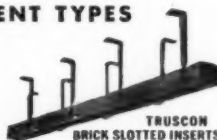
...the electrical contractor's answer to the problem of:

- anchoring** motors, blowers, transformers, etc. to ceilings, walls and columns.
- fastening** electric cables to ceilings and walls or in tunnels and subways.
- suspending . . .** lighting fixtures from ceilings, walls or columns.
- carrying** auxiliary framing which supports the various cables, wires and other instruments in telephone systems.

FOUR DIFFERENT TYPES



TRUSCON SLOTTED INSERTS



TRUSCON BRICK SLOTTED INSERTS



TRUSCON ADJUSTABLE INSERTS



TRUSCON TAPPED INSERTS

Truscon Pressed Steel Inserts are placed in the correct, desired position BEFORE the concrete is poured. Saves time, labor, money. Assures correct placement of fixtures and easy, quick changes.

WRITE FOR ILLUSTRATED LITERATURE!



TRUSCON STEEL COMPANY

6216 Truscon Ave., Cleveland 4, Ohio • Subsidiary of Republic Steel Corporation

Port-A-Pony featherweight Portable PIPE THREADER

Truly a feather weight, the Port-A-Pony weighs only 26 pounds and is ideal for threading conduit and pipe in the shop or field. Use the Port-A-Pony to thread any 1/4" to 4" pipe in place. The 1/2 h.p. reversible motor operates on 110 volts AC or DC. Heavy duty case hardened gears are mounted in a rugged magnesium alloy casing. Adaptable to your die stocks. Write for full information today.



THREAD-EZY MFG. CO.

CORUNNA MICHIGAN



NISA STAFF ENGINEER Raymond E. Wilson has the responsibility of correlating technical data for member shops. Before joining NISA, Mr. Wilson was plant engineer of the Empire Ordnance Corp. at Wissahickon, Pa. Previous to that he was superintendent of the repair division for Westinghouse Electric Corp. in Philadelphia.

is best achieved by design for lowest annual cost. That cost includes operation and maintenance expenditures as well as initial investment.

Another part of No. 1 plainly implies that, when materials become scarce in an emergency, they should be allocated by people who understand 1) what is essential in a permanent structure, and 2) how much the use of inferior substitutes will cost in terms of long-range conservation.

BRAB's report makes a sharp distinction between inferior substitute materials and alternates that are as good as—or better than—historically accepted products. It comes out strong for performance standards—particularly on Government work—that freely admit the use of alternates.

Another point that it pushes strongly is the opening up of Government standards (Codes and Specifications) and the revision of contractual relations with architects and engineers to stimulate professional ingenuity in the development and application of new design ideas. That objective requires changes in appropriation procedures followed by the agencies.

The broader design and construction standards, it says, should apply Government-wide to all agencies engaged in building construction. To that end, the agencies ought 1) to join with organizations that write and revise standards for uniform adoption, 2) to support research and take part in it, 3) to coordinate their own research programs, and 4) to form an interagency mechanism for constant collaboration. The collaboration, it points out, should include the agency administrators, to make sure that technical advances



They're all needed to keep steel production up ...TO AID DEFENSE

Every pound of unused iron and steel you have is needed to help steel mills and foundries keep production up to rising capacity.

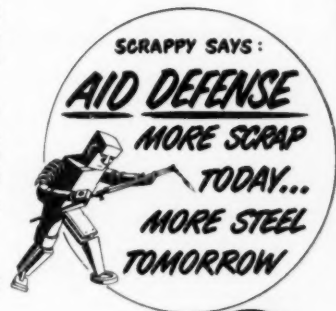
Scrap inventories are alarmingly low. Mills that normally maintain inventories of several months, are now down to a day-to-day basis. Shut-downs are threatened.

NON-FERROUS SCRAP IS NEEDED, TOO!

This advertisement is a contribution, in the national interest, by

One way we can maintain desired level of both military and civilian production is for you to *dig up* and *turn in* your iron and steel scrap now.

Get in touch with your local scrap dealer and write for the free booklet, "Top Management: Your Program for Emergency Scrap Recovery" to Advertising Council, 25 W. 45th St., New York 19, N. Y.



McGRAW-HILL PUBLISHING COMPANY, INC.

330 WEST 42nd STREET, NEW YORK 36, N. Y.



Spliced for Life!



IDEAL

Wire-Nuts®
Patented, No. 1,932,555

THE SOLDERLESS, TAPELESS WIRE CONNECTORS

are now **Fully Approved**
for **ALL** "Pigtail" Splices in **ALL**
Types of Branch Circuit Wiring

Now you can use IDEAL "Wire-Nuts"—the industry's favorite wire connector—from cellar to attic and all over the shop or plant! Con-

tractors sizes 74B and 76B are fully approved as pressure cable connectors for general use—with conduit, armored cable, non-metallic sheath and open wiring—for all common wire combinations. Use them on every job — and profit from the easiest, simplest method known for making stronger, safer pigtail splices that last a lifetime. Order a generous supply today!



**MAIL FOR
FREE SAMPLES**

IDEAL INDUSTRIES, Inc.
1041 Park Avenue, Sycamore, Illinois
Please send me free sample of
IDEAL "Wire-Nuts"

Name _____
Company _____
Address _____
City _____ Zone _____ State _____

**SOLD THROUGH
AMERICA'S LEADING
DISTRIBUTORS**

aren't blocked by administrative ignorance.

"In some phases of building technology", BRAB declares, "the absence of standards is a handicap to conservation. Standards are fairly well defined for all fields of engineering, but much is to be done for space and planning."

As an incentive to professional ingenuity of architects and engineers, the Advisory Panel on Space and Planning advised Government agencies to throw away standard plans that freeze design. But on one special type of building, the panel says it would be worthwhile for the three military agencies to have one standard general warehouse design. Instead of standard plans, the panel recommended more Government effort to improve programming of building requirements, with special regard for variations in climate in different geographical locations. It also proposed periodic opportunities for outstanding architects and engineers to go all out on new designs for the Government, unrestricted by ordinary design standards.

In making up its list of recommendations for electrical systems, the Electrical Systems Advisory Panel brought out a suggestion that the AIEE be urged to develop a comprehensive design manual for the most common typical electrical installations. Such a handbook would cover much more than the minimum requirements of the National Electrical Code and the design standards in the manual of the Illuminating Engineering Society. Useful as such a guidebook would be, the panel decided that its preparation would take too much time.

As its report shows, there was no question of the use of aluminum conductors by the electrical panel. Aluminum has already been approved for most of the electrical uses to which it can be applied. The panel made 26 recommendations for interior wiring—including use of higher-voltage circuits—and urged the AIEE to speed its investigation of circuit neutrals for grounding.

On service entrances, the electrical panel recommended use of non-critical cable and higher voltages. For site distribution, it proposed overhead construction and alternate materials, among other things, in addition to higher voltages. The panel also called for research on electrolytic corrosion of underground cable. In electrical equipment, it recommended use of alternate materials and methods in the interests of conservation.

Representing the electrical construction industry on the Electrical Systems Advisory Panel were: J. R. Meehan, Fischback, Moore & Morrissey, Inc., Chicago; and K. D. White, White Electrical Construction Co., Atlanta.



NEW PRESIDENT of the Electrical Maintenance Engineers Association in Chicago, Leon D. Cook (left) of the Commonwealth Edison Co., receives congratulations of retiring president Edward J. Fitzgerald, E. I. DuPont de Nemours Co. Other E.M.E. officers are vice president—T. J. Peters, United States Steel Co.; program chairman—W. A. Perry, Inland Steel Company. The organization has a roster of more than 500 engineers representing Chicago area firms.

DATES AHEAD

Illuminating Engineering Society—Annual Technical Conference, Edgewater Beach Hotel, Chicago, Ill., September 8-13.

International Association of Electrical Inspectors—Northwestern Section, Twin Falls, Idaho, September 11-13; Southwestern Section, California Hotel, Fresno, Calif., September 18-20; Eastern Section, Hotel Statler, Washington, D. C., October 2-4; Western Section, Hotel Hollenden, Cleveland, Ohio, October 6-8; Southern Section, Hermitage Hotel, Nashville, Tenn., October 13-15.

National Electronics Conference—8th annual conference, Sherman Hotel, Chicago, Ill., September 29-Oct. 1.

National Electrical Contractors Association—Annual convention, Hotel Morrison, Chicago, Ill., October 5-10.

Electrical Industries Show—Sponsored by the Eastern Electrical Wholesalers Association, 165th Regiment Armory, New York, N. Y., October 14-17.

National Farm Electrification Conference—Hotel Statler, Detroit, Mich., October 20-21.

National Industrial Service Association—Southeastern Chapter meeting, Miami, Fla., Oct. 24 and 25.

National Electrical Manufacturers Association—Haddon Hall Hotel, Atlantic City, N. J., Nov. 10-13.

American Institute of Electrical Engineers—Winter general meeting, New York, N. Y., January 19-23.

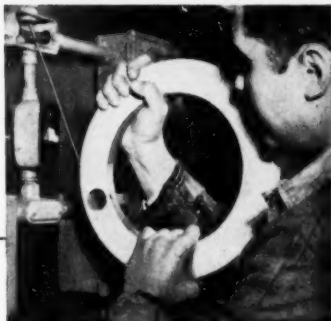
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**Magdsick Named
1952 IES Medallist**

H. H. Magdsick of the General Electric Company, Nela Park, Cleveland, has been named to receive the 1952 Gold Medal of the Illuminating Engineering Society. This Medal, highest honor in the field of illumination, is awarded for meritorious achievement conspicuously furthering the profession, art or knowledge of illuminating engineering.

Presentation of the Medal will be made at the Society's Annual National Technical Conference at its opening session in the Edgewater Beach Hotel, Chicago, on Monday, September 8.

Mr. Magdsick has made notable contributions to illuminating engineering through a period of over 40 years. President of the Society in 1929-30, he was among the first to be raised to the grade of Fellow when this grade of membership was established in 1945.

Mr. Magdsick graduated in 1910 from the University of Wisconsin with a degree of Electrical Engineering, at which time he joined the National Electric Lamp Association at Cleveland. In 1919 he was made Director of Commercial Engineering for the National Lamp Works of the General Electric Company, and in the consolidation with Edison Lamp Works he became Executive Engineer.

His IES responsibilities have included the chairmanship of such committees as Papers, Industrial and School Lighting, Motor Vehicle Lighting, Lighting Legislation, National Convention, and IES-Beaux Arts Prize.



BEST POINTS of coil winding machine are given by R. E. Trussell (left), Potter & Rayfield, Atlanta, Ga., to Loren Wright, Ball Electric Co., Waukegan, Ill.; George Larsen, Larsen-Hogue Electric Co., Los Angeles; and J. J. Rick, Rick & Selleg, Chicago. Place: Recent Convention of the National Industrial Service Association in Chicago, Ill.

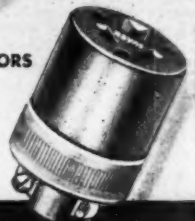
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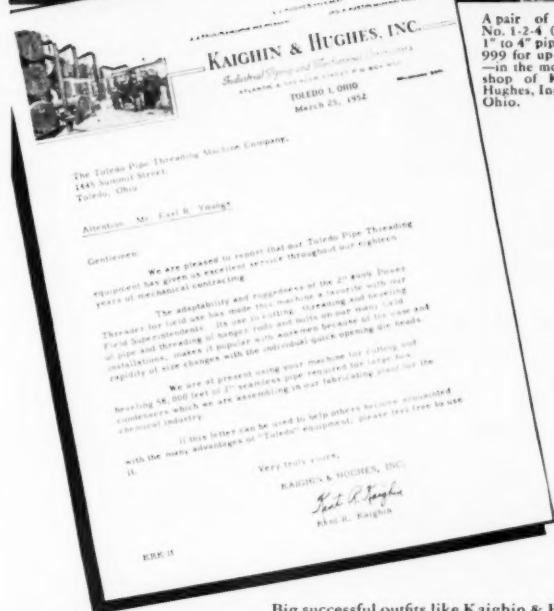
MOTOR SHOP PROBLEMS are aired at Chicago by: (L to R) H. W. Mentrup, Nola Electric, Inc., New Orleans; J. D'Arcangelo, Industrial Electric Inc., New Orleans; Sam D. Cavataio, Illinois Electric Works, Inc., East St. Louis, Ill.; and M. B. Hutson, Industrial Electric, Inc., New Orleans.

NISA News

As reported by Frank Martin, Jr. the Niagara Chapter of the NISA has been very active this spring. At the meeting on March 14, president Glenn Frostdick was elected for another year. Ralph Barker, Barker Electric Co., Niagara Falls, N. Y. was elected secretary-treasurer. A discussion of shop methods followed the election of new officers; then a movie of the production methods in the Delco Manufacturing plant and a movie of generating plants in the New York City area were shown.

The meeting of April 18 started with dinner as usual at the Forty & Eight Club in Buffalo. After a short business meeting, all members went to the Cheektowaga, N. Y. plant of the Westinghouse Electric Co. They were taken on a tour of the Motor Division and wire drawing department. It was interesting to compare job shop methods with production methods in making electric motors.

The meeting of May 16 was held in the University Club, Syracuse, N. Y. The members who came from Niagara Falls, Tonawanda, Rochester and Buffalo found the Syracuse men excellent hosts. There were informal tours of the Syracuse member shops in the afternoon preceding the meeting. Members were treated to sage advice from C. F. Hilton who's been in the motor business some 30 years (Rodgers & Hilton, Syracuse, N. Y.). Lowell Bellingham, National Varnish Products Co., gave the latest information on new plastic tapes. About 35 members were present.



A pair of Toledo—No. 1-2-4 (at left) for 1" to 4" pipe; and No. 999 for up to 2" pipe—in the modern pipe shop of Kaighin & Hughes, Inc., Toledo, Ohio.

Big successful outfits like Kaighin & Hughes, Inc. are among the many users who have found TOLEDO Power Pipe Machines "tops" for high production... easy operation... long life... and low upkeep.

Especially popular in pipe shops or in the field—Toledo No. 999 2" Portable Power Threader! Threads 2" pipe in 22 seconds... cuts off in 10 seconds. Built to last with the rugged precision of a fine lathe. Many No. 999's in use 20 years and more! This means lower monthly cost—another advantage of Toledo dependability! Write for new catalog. The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office: 165 Broadway, Room 1310.

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Meeting of Quaker City Chapter was held May 14th at Beck's on the Boulevard in Philadelphia, Pa. President Wagner presided. The chair then called for a minute of silence in regretful commemoration of the death of Albin Traceski of the firm of Ampere Electric Co. of Philadelphia. Roll call showed 31 present. Treasurer's report read by William M. Hendrickson.

C. R. Durand commented on the Chicago convention. Asked for opinion from the members present who had been to the convention on the way the forums had been handled, i.e., in the shape or form of larger forums rather than the smaller ones as heretofore. A showing of hands indicated divided opinion.

C. R. Durand then proposed that the secretary be instructed to write National headquarters, putting in a bid on behalf of Philadelphia for the convention in 1955. Motion seconded by Samuel Augustine and carried.

Mr. Storck, Chairman of the Nomination Committee, reported the following nominations for the respective offices: President, William J. Engel; Vice-President, Samuel Augustine; Treasurer, Wm. M. Hendrickson; and Executive Committee, Messrs. Eisenhardt; Davies; Albertson.

Additions to nominations were asked of the membership and there being no additions, a motion was presented by Mr. Marino that the Secretary cast a unanimous ballot for all officers as designated by nominating committee. Motion was seconded by Mr. Storck.

• • • • •

The New England Chapter held its regular meeting at Hotel Bradford on May 8th. The meeting was called to order by the president, Harry Bedig. Sixty members were in attendance.

The budget figure of \$1,690 for the year was read into the records by the president. After this, a few remarks were made by Program Chairman Kolhonen. The minutes of the previous meeting were read and accepted.

New committee chairmen are as follows: Membership, B. Rosenberg; By-Laws, B. Whittemore; House, H. Myerson; Tickets, A. Tracy; Reception, B. Whittemore; Ideas, P. Leicht; and Publicity, Paul Keating.

The meeting was turned over to the program chairman who stated that there were 31 members at the National Convention held in Chicago. He called on Mr. and Mrs. Elson to give condensed reports of the activities there. Mrs. Elson gave an interesting talk on the women's activities and from her reports a good time was had by all. New England was well represented, having 12 shops registered at the convention.

At the suggestion of Mr. Kolhonen a

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BUSY CHECKING product literature at NISA Convention Exhibit are: (L to R) N. W. Finnie, Ampere Electric, Ltd., St. Catharines, Ontario, Canada; J. W. Foulke, Electric Motor Service Co., Indianapolis; and Carl Reifeis, Moran Electric Service, Inc., Indianapolis.

rising vote of thanks was extended to Mr. and Mrs. Elson for their services as social leaders at our past convention. Harry Bedig then offered a few comments on his observations at the convention. Other members who spoke were Reddington, Sweeney, Munroe, Tracy, Worth, Leicht, Sandman, Smith and Kolhonen.

The program chairman introduced Charles Guy, of the Safety Seal Co., who was the speaker for the evening. His talk on Safety Seal was followed by a question and answer period.

• • • • •

The Chicago Chapter (Electric Motor & Service Association) went ahead and held its regular meeting April 8, less than two weeks before the national meeting was underway. Paul Martin gave a blackboard delineation on variable speed motors. Robert Roos, Roberts Electric Co., Chicago, was a guest.

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Highlight of the April 8 Los Angeles Chapter meeting was a talk on pricing, coverage and results of the Biddle Trade Bureau's service to the electrical industry by A. H. Guthrie. William Hill, Hill Electric Co., also spoke on apprentice training.

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H. A. Holden Co. served breakfast to 27 members of the North Central Chapter at the Spaniol Hotel, St. Cloud, Minn., March 30. Arch Lackore, Lackore Electric Co., Winona, Minn., was elected President; Warren Mielke, Mielke Electric Works, Duluth, Minn., Vice-President; Bob Rott, Electric Motor Supply Co., Minneapolis, Secretary-Treasurer. Fol-

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COMBINED PRECISION OHMMETER & MEGOHMMETER
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It had 13 rolls.
It was the original
baker's dozen and
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quite a break.**



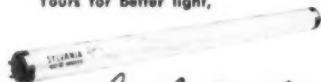
But the baker's dozen can't be compared to the extra value you get today from Sylvania Fluorescent Tubes.

Y'see these Sylvania Tubes are rated at 7500 hours.

Just try 24 Sylvania tubes and get our Certificate of Assurance from any Sylvania Distributor. Then, if after a trial installation these tubes don't out-perform any others, simply return them with the certificate and you'll get your money back. Wow!

Of course there are a number of hard-to-pronounce chemical words that tell why we dare make an offer like this, but they sound too much like selling talk. So, all I say is try Sylvania tubes . . . I know they'll save you money!

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I'd like to know more about Sylvania Tubes' better performance and bigger savings. Please send me a copy of "How to get the most from your Lighting Dollars." (FL-408)

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lowing the business meeting, the Holden Co. showed a Lincoln Electric Co. film on arc welding and a comedy film. Gordon Kunde presented a paper on "Shop House Keeping," William Sagl gave a paper on "Silastic Insulation," and George Svendsen read a paper on "Multi Speed Squirrel Cage Motors."

• • • • •

New officers of Puget Sound Chapters are Earl S. Brooks, United Electric Motors, Inc., Seattle, and J. Calvin DeVere, Motor Shop, Kirkland, Washington, Secretary-Treasurer. "Overhead Allowances in Government Contracts" was the subject of a talk by Walt Harmier, Center Electric Engineering Corp., Tacoma, Washington, at the April dinner meeting. The May 5 Meeting was held at Seattle-Tacoma airport—a gesture to the Tacoma members.

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New officers of the San Diego Chapter are: President, John H. Lough; Vice-President, Ted F. Clute; Secretary-Treasurer, R. L. Pontius.

• • • • •

On Saturday, June 7, the New York NISA Metropolitan Chapter's first Foremen's Meeting, held at the Oyster Bay Restaurant, Jersey City, New Jersey, with over 115 in attendance proved to be a huge success. Shop visitations were under the able management of Stanley Bojak.

Finally, after partaking of many inspiring, lively and interesting doings, arranged by Chairman George Lockwood and his energetic committee, the Foremen's Meeting got started at 7:00 p.m. at the Oyster Bay Restaurant. Milt Volker gathered together some 46 varied interesting and educational exhibits of merit for the foremen's keen Gadget Contest, and after due deliberation by our able judges, Joe Wagner and Ben Caplan of Philadelphia, Pa., Harry Herold of Troy, N. Y., and Joe Piela of Norwich, Conn., prizes were awarded as follows: \$25 first prize to Oscar Hafener, Electric Enterprise Company; \$15 second prize to Jim Dav, Lockwood Electric Motor Service Co.; \$10 third prize to Bob Jones, Standard Electric Motor Repair; and \$10 fourth prize to Emil Strannemar, Willis Motor & Armature Works.

Ten additional \$5 prizes were given to other contestants.

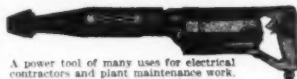
Our good friend Bill Kauppert in charge of the prizes says, "Next Year we hope to have a bigger and better Foremen's Meeting."

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Electrical Construction—
Maintenance—Repairs**

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- 6—Cater Hammer Safety Switches, 600 Volt capacity.
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- 3—7½ H.P. Westinghouse Motors & Starters
Constant Speed 835—1730 R.P.M. 208 V. 60 c.

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- 4—20 KW Motor Generator Sets
Motors: Westinghouse, General Electric, Allis Chalmers 30 H.P., 440 v. 3 ph. 60 c. 1750 R.P.M.
Generators: Westinghouse, Imperial, Allis Chalmers 20 KW, 1750 R.P.M., 125 Volts

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Motor: Westinghouse 220/440 V. 3 ph. 60 c. 850 R.P.M.
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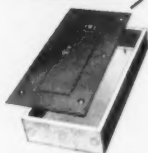
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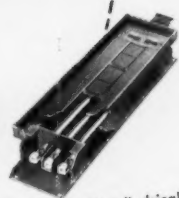
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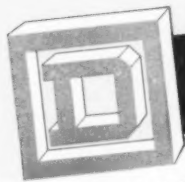
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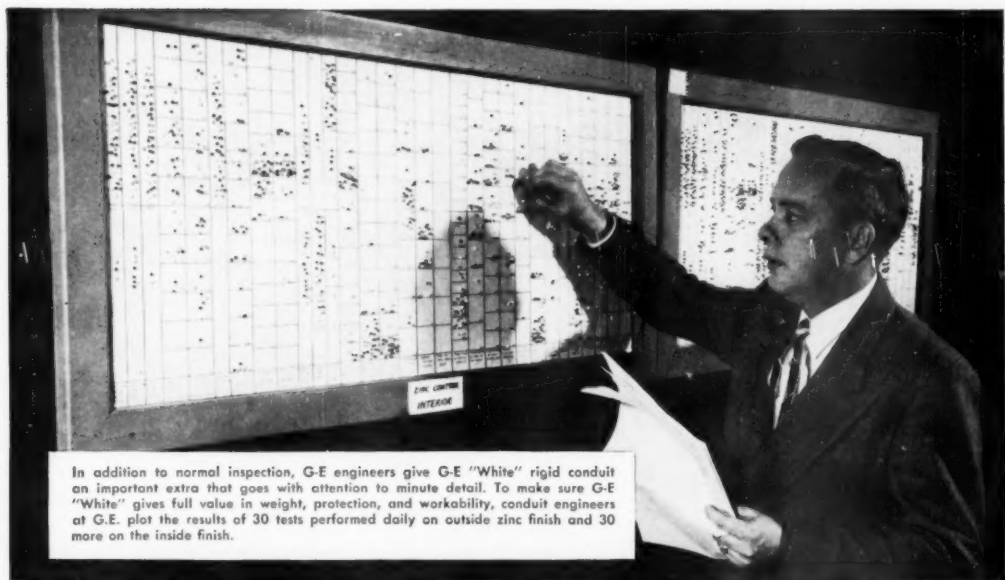
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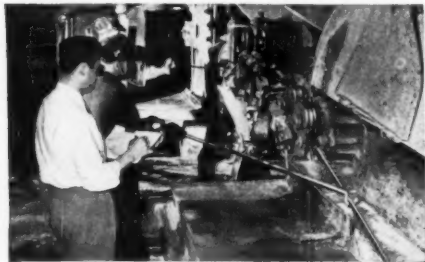


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G-E "WHITE" takes 60 tests a day for its engineering degree



Data from these tests are compiled by the General Electric Conduit Department and computed to establish the relation of one test to another. Quality-control mathematicians take charge of this important function in conduit engineering.



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At General Electric, engineers plot the results of 60 tests made each day on G-E "White's" zinc finish—tests that include every factor that may affect the uniformity of conduit. They check the temperature and humidity in the plant, the temperature of raw pipe and molten zinc, and the temperature of the water in the quench tank. They keep close watch on the chemical purity of the zinc, record the concentration of iron sulphide and sulphuric acid in the pickle solution.

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